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Science, Technology, Engineering, Mathematics: Achieving world class skills for London

The London Skills Commission brings together:

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Confederation of British Industry
Association of London Government
London Higher
London Sector Skills Forum
Jobcentre Plus
Southern and Eastern Region Trades Union Congress
London Chamber of Commerce
Association of Colleges London Region
Higher Education Funding Council for England
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Foreword from Ken Livingstone, Mayor of London

It is critical to London's economic prosperity that young people are motivated to study and take up careers in Science, Technology, Engineering and Mathematics (STEM). From biotechnology to the creative and cultural industries and from financial and retail services to computing, the sectors of London's economy which are key to a high skills and high productivity future depend on scientific innovation and the range of knowledge that education in science and technology brings.

I want London to continue to have a thriving economy where the world's top science, technology and engineering companies have their headquarters and where all Londoners can benefit from the economic opportunities offered by STEM. I also want to ensure that London's schools, colleges and universities attract and retain teachers and lecturers who can inspire and lead the intellectual development of the capital's scientific knowledge and skills base.

However, increasingly children and young people are being put off learning about science, technology, engineering and maths. And many of London's schools, colleges and universities are finding it hard to keep the STEM teaching and support staff they need.

This report is important as it helps employers, learning providers and policy makers to understand why this is happening. For example, it highlights some of the problems London's educational providers face in recruiting teachers and lecturers with up-to-date knowledge and experience of the practical application of science, technology, engineering and maths. But it also provides a range of possible solutions, giving examples of how STEM study and careers can excite and inspire children and young people, thereby allowing them access to the knowledge and skills needed to work in the sectors which will provide the most interesting and rewarding jobs of the twenty-first century.

The London Development Agency (LDA) and the Learning and Skills Council (LSC) jointly commissioned this report to find ways in which young people, adults and employers in London can better engage with science, technology, engineering and maths. I welcome the findings of this report and urge the relevant bodies responsible for the future of London to work together to implement its recommendations.

Ken Livingstone
Mayor of London

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Executive summary

Science, Technology, Engineering and Mathematics (STEM) skills play a crucial role in the UK economy. Over the coming years this importance is likely to increase. High technology will form the basis of new industries, while an increasingly wide range of economic sectors will depend on high level skills. At the same time, STEM is seeing increasing global competition.

There is evidence of a STEM skills gap in the UK. Businesses are not getting the employees with STEM skills that they need. Concerns have been raised at the national level about the UK's performance in STEM skills, and its ability to compete internationally. The Roberts and Lambert Reviews and the Adrian Smith Inquiry in particular contain stark messages for government, business and education providers.

Against this background, 'Science, Technology, Engineering, Mathematics: Achieving world class skills for London' focuses on the specific challenge to London in closing the STEM skills gap. For the first time, it looks at the STEM skills picture in London, and the London-based action that needs to be taken.

This report brings together and presents the evidence base for action in embedding STEM skills in London. It is intended to provide support to policymakers and provision planners. It gives the perspective of young people, employers and learning providers in London on the problem of the STEM skills gap - where the main skills shortages are, and what can be done about them.

The key findings of this report

- Many young people have **false impressions of STEM subjects**, seeing them as more difficult, less well taught and more boring than other subjects. Young people, careers advisers and teachers rarely see the STEM sector as offering stimulating, exciting and well paid career opportunities. Rather than being associated with innovation and new and emerging industries, many young people still associate STEM with the old economy.
- **Some STEM industries are increasingly dispersed within London**. This creates a number of difficulties.
- **Low wage premiums in some science and engineering-related careers are a major problem in London**. This makes some STEM-related careers (in finance for example) much more attractive than others.
- STEM suffers from a **lack of positive media coverage** and although STEM advocacy and promotion is increasing, it is also un-coordinated. As a result increasing numbers of young people are choosing not to opt for STEM related study and careers.
- The **National Curriculum hampers teachers** who want to introduce interest and innovation into the delivery of STEM learning to maximise pupils' enjoyment.
- The **crucial age in capturing students' interest in STEM is around 13 to 14**. This is the key time when proper career guidance, and stimulating teaching, can motivate young people to decide on further STEM study and eventual STEM careers.
- The **lack of vocational content in many STEM degrees** limits the relevance of study to the world of work - employers also report a **lack of general employability skills**, such as communication skills, amongst many STEM specialists. Many FE (Further Education) Colleges offer training at too low a skill level, and also deliver skills for the old economy rather than providing those needed by expanding new technology or new engineering business areas.
- **SMEs have particular problems recruiting skilled employees**, because they cannot pay the wage premiums expected in the capital.
- Employers would like a **more co-ordinated and long term approach to skills funding**, while skills **provision needs to reflect the needs of STEM industries**.
- Many migrants to the UK have higher level skills, and yet they cannot use these skills in the London labour market.
- It is extremely **difficult to attract and retain good quality STEM teaching staff** for schools, FE colleges and universities in London. The pay differential between FE lecturers and school teachers is causing severe problems in the recruitment and retention of STEM teaching staff in the FE sector. There is an acute shortage of Level 3 technicians caused in the main by poor pay, which further undermines STEM education capacity within London.
- **Widening participation** among under-represented groups can help close the STEM skills gap, as can **encouraging 'returners'** to STEM careers.

What needs to be done

This report ends with a number of specific recommendations for action to help embed STEM skills in London.

To **improve collaboration between policy makers, STEM learning providers and businesses**, STEM studies and careers must be promoted.

- Consider setting up a **partnership of STEM learning providers**. This would take forward existing successful STEM initiatives and initiate new schemes to address gaps.
- **Develop a strategic STEM group** to include members from STEM industry and brokers of existing industry/provider links, beginning with London SETNET (Science, Engineering, Technology and Mathematics Network).
- Produce and **make available to learning providers a directory of the main sources of funding** available to support STEM.
- To **improve the image of STEM subjects and careers**.
- Improve the information and support available to those who influence the study and career decisions of young people, so that they can provide informed advice on the opportunities of STEM. This should include raising the quality and frequency of Information Advice and Guidance services and careers support in schools, Further and Higher Education institutions.
- Support a regional (potentially national) public awareness **campaign to promote closer industry links to schools and F/HE institutions**.
- **Increase the numbers of young people studying STEM subjects** at school, college or university, for example through a high profile media campaign to raise awareness of STEM subjects and careers.
- **Improve the capacity and flexibility of providers** of school, further and higher education to tailor provision **to meet employers' and individuals' STEM skill requirements**.
- **Motivate and enable employers to seek out STEM training for their employees**, for example by producing and making available a range of clear information on ways that employers can develop the skills of their workforce.
- **Improve the quality, relevance and access to statistical labour market information** available to support STEM skills actions.
- **Extend the use of role models, ambassador schemes and technology competitions** to promote STEM to young people and encourage closer links between STEM businesses and schools, FE Colleges and HE (Higher Education) Institutions.
- **Seek to increase STEM teachers' salaries** and to equalise pay between school teachers and FE lecturers.
- Provide **STEM taster courses for students and potential 'returners'** to STEM.
- Seek to attract new recruits from a more diverse labour market. Including recognising or updating overseas qualifications and providing other support for migrants to enter the London labour market at higher levels.

The problem: The skills gap in Science, Technology, Engineering and Mathematics (STEM)

Why STEM skills are important for the UK

"Science is vital to our country's continued future prosperity". Prime Minister Tony Blair[1]

Industrial sectors that depend on STEM skills play a crucial role in the UK economy. At the start of the twenty-first century they contributed over £68 billion per annum to the UK GDP, representing 10% of the total. They accounted for more than one third of total UK exports.[2]

Over the coming years, this importance is likely to increase. The Government predicts that high technology areas, including nanotechnology, quantum computing, photonics and sensors, will form the basis of new industries in the future.[3]

At the same time, STEM is seeing increasing global competition. Leading companies recognise that rapidly developing countries, including China and India, will see high rates of STEM growth and will be increasingly important players in research and development for large science and technology-based companies.[4]

According to Chancellor of the Exchequer Gordon Brown,

"the nations that can thrive in a highly competitive global economy will be those that can compete on high technology and intellectual strength – attracting the highest-skilled people and the companies which have the potential to innovate and to turn innovation into commercial opportunity. These are the sources of the new prosperity".[5]

In the UK, our economy will depend on high level STEM skills across a wide range of sectors. They will be increasingly applied in professional services, in the finance sector and in advanced research. STEM skills will also be needed in broadcasting and in the creative and design sectors.

The engineering sector in particular is undergoing major change which will lead to many new technological and business developments. Important factors include the convergence of computing and telecommunications and the application of newly emerging technologies such as biotechnology and nanotechnology. These industries are increasingly seen as making up a 'new' engineering sector.[4]
A noticeable feature of both traditional and new engineering employment has been a shift towards higher-level occupations in terms of skills and education requirements, and this is expected to continue in the future.[2]

This move in employment towards higher-level professional and technical occupations is occurring in many different sectors. It results in a growing need for people with STEM skills qualifications, such as graduate engineers and higher level technicians.

The STEM skills gap: The national picture

Evidence of a skills gap

Across a wide variety of sectors, there is evidence that businesses are not getting the employees with STEM skills that they need.

In engineering, there have been difficulties in recruiting professional engineers, scientists, technologists, technicians and craftspeople.[2]

In general, two main factors have been highlighted as reasons for recruitment difficulties; a lack of applicants with the required qualifications and skills (64%); and a lack of applicants with the required work experience (27%).

EMTA (Emerging Markets Trade Association) suggests[2] that skill deficiency problems were greatest among the following groups.

- Professional engineers, scientists and technologists.
- Technicians.
- Craftsmen and women.

The New Engineering Foundation Fellowship Scheme lists engineering and technology disciplines. This gives a useful picture of just how STEM employment is changing as it includes areas of increasing demand for STEM skills.[6]

- Biometric and biosystems engineering
- Gaming and leisure technologies
- New energy technologies
- Robotic engineering and cybernetics
- Sports and leisure engineering
- Security and surveillance technologies
- Ubiquitous and pervasive computing technologies.

Skills Foresight 2000[2] also made a number of recommendations for industry to gain and maintain competitiveness. There needs to be:

- greater multi-skilling and greater flexibility
- greater ability to deal with change
- an improvement in personal and generic skills
- an increase in management/leadership skills
- a greater level of customer service skills and customer awareness
- an ability to continue learning and re-skilling
- an improvement in basic literacy and communication skills for clerical work.

Concern at the national level

The UK Government has recognised the need to drive up scientific excellence and innovation, to enable Britain to compete internationally. It has also responded to a number of important reviews of UK performance in STEM skills and subject areas within the economy and education.

In January 2004, the Chancellor of the Exchequer announced that the Government would develop, as part of the Spending Review 2004, a 10 year investment framework for public and private sector investment in UK science and innovation, to provide a secure medium-term platform for innovation and productivity growth. This was followed in June 2004 by the publication of the Government's science and innovation framework. Annual science funding will increase by 5.8% in real terms over the decade beginning 2006/2007, providing an additional £1 billion funding for science for the period of the Spending Review.

The growing determination to act on science and innovation by government has been fuelled by the outcomes of a number of important reviews. The Roberts Review "Set for Success" (2002) and the Lambert Review-University Collaboration are particularly significant within the context of this research.

The stark messages for government, business and education providers arising from these reviews were reinforced by the Adrian Smith Inquiry into Post 14 Education "Making Mathematics Count" (2004).

The Roberts Review concluded that significant problems inherent within the education system, and in many science, technology and engineering industries, represent a substantial brake on economic competitiveness within the United Kingdom.

The Lambert Review signalled the need for much better connections between university and business, to enhance the relevance of higher level education. It highlighted a role for Regional Development Agencies in making this happen.

The Adrian Smith Inquiry concluded that many of the generic problems in science and engineering, which the Roberts Review identified, applied most seriously to mathematics. This was chiefly because of shortcomings in the teaching of mathematics in the UK. (The key aspects of these reviews are summarised in Appendix 1).

Richard Baker

The purpose of this report: London and the STEM skills gap

What's new about this report: The focus on London

Against this background of concern at the national level, this report focuses on the specific challenge to London in closing the STEM skills gap. For the first time, it looks at the STEM skills picture in London, and the London-based action that needs to be taken.

The report has been prepared for the London Skills Commission's Higher Level Skills Flagship Group. The London Skills Commission, which is made up of the key education and skills planning, funding and delivery bodies in London, sets out a common vision and a shared framework within which all planning, funding and delivery of skills and employment support takes place in the capital. Its aim is "for London to achieve a healthy and dynamic labour market accessible to all London's residents and delivering benefits to employees, employers and the wider community".

Higher Level Skills (HLS), in particular within science, technology, engineering and mathematics, has been identified as a priority area for the London Skills Commission's Delivery Programme.

Why this report was commissioned

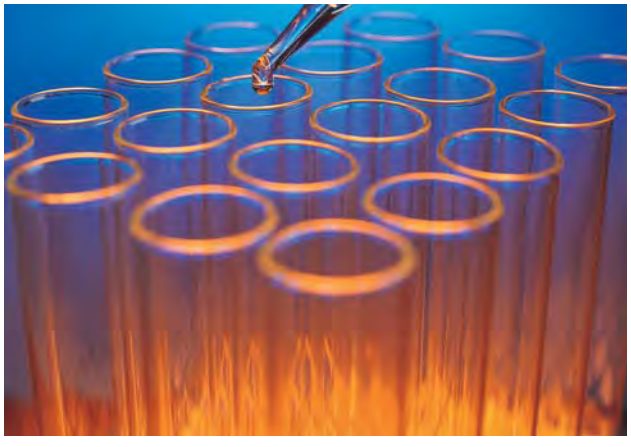
This report is intended to underpin the wider HLS Flagship Programme, which aims to embed STEM skills in London. The conclusions of this report include a number of recommendations for strategic actions, to help improve the quality and relevance to industry of STEM skills supply within London.

This research is designed to produce an evidence base for activity to address a critical shortage of STEM skills in London. This shortage constitutes a real threat to the capital's productivity and its ability to compete on the international stage. As London has historically led the rest of the UK in productivity levels, this shortage is a problem not only for London but also for the rest of the UK.

The Flagship Group has already undertaken phase one of its research: an analysis of the 'supply-side' STEM skills on offer and the major barriers that learning providers face in trying to improve them. That research looked in particular at how far FE colleges and universities were addressing the findings of the Roberts Review.[7] It recommended that best practice needed to be shared much more widely and effectively between learning institutions, and that much closer links should be developed between industry and business.

This report is designed to help policy makers, funders, learning providers, employers, and other agencies that support and advise young people, to ensure that London has a world-class supply of STEM skills. This supply has to meet the needs of business in London in an increasingly competitive international market.

This report brings together and presents the evidence base for action in embedding STEM skills in London. It is intended to provide support to policymakers and provision planners. It gives the perspective of young people and employers in London on the problem of the STEM skills gap - where the main skills shortages are, and what can be done about them.



The HLS Flagship Group's research and recommendations have already played an important part in determining the policies of agencies developing HLS. For example, the first stage research has informed the corporate plans of the major funders who form part of the London Skills Commission.

In addition, the Flagship Group has contributed to the SEMTA (Science Engineering Manufacture Training Agency) and E-Skills Sector Skills agreements, and will continue to work closely with the Sector Skills Councils as they customise their delivery to match regional priorities. The message that STEM HLS are crucial to London's future has also influenced the current round of European Social Fund co-financing.

How the research was carried out

In carrying out their research, consultants Rocket Science employed a combination of desk research and primary research.

The desk research involved reviewing published materials on the higher level STEM skill needs of employers, young people's perceptions of opportunities and barriers in pursuing STEM studies and careers, and examples of best practice among employers, schools, colleges and universities and employer federations. The outcome of the desk research is not presented in a separate section within the report, but informs the whole of it.

The primary research made use of focus groups of young people, questionnaire surveys and one to one interviews. The primary research was designed to gather a wide range of views from within London's STEM skills supply and demand infrastructure.

The report includes direct statements from young people, employers and learning providers. These statements represent the views of those interviewed and include a degree of subjectivity. They cannot be applied to all students, providers or employers. However, there was a large amount of commonality between the views expressed by the various representatives of stakeholder groups. Views also reflected the findings of the three major pieces of research into STEM skills conducted between 2002 and 2004: The Roberts and Lambert Reviews and the Adrian Smith Inquiry.

Quotes from young people used in this report are from three focus groups, each of between five and twelve students, aged between 16 and 26. These students were from FE colleges, school sixth forms, an Access Course and a university, chosen as being representative of many in London.

Tom Dixon

Why STEM skills in London are important

For London itself

London's scale, diversity and position as one of the worlds leading cities and as Europe's major financial centre creates unique challenges and opportunities for the promotion and development of STEM skills. London is a unique UK city, the nation's main location for global business, and it is characterised by its high productivity, size, and great economic and demographic diversity. London's increasing diversity - more languages are now spoken in London than in New York - is increasingly an important factor fuelling economic growth. New business ideas, new skills and a determination to succeed are all part of the new diversity.

London's economic prosperity depends on the ability of its businesses and workforce to thrive in a high-productivity, high-value economic environment. The international dimension and dynamic structure of London's residential and employee communities means that its businesses generally have access to a highly trained labour force and experience fewer skill gaps than the national average. If London is going to maintain its competitive position on the international stage, both businesses and the workforce need continually to improve their skills.

Sustaining Success,[8] the capital's draft Economic Development Strategy, is based on the idea that London's high productivity is supported by the clustering of activities and people within London. This clustering also results in high costs, however, with people and businesses having to compete for often scarce resources. Significantly, the pressure on achieving and sustaining high productivity prevents London from offering low value economic activities, compared with either the rest of the UK or its global counterparts. This means that the city's future economic prosperity depends upon businesses and people who can succeed in a high productivity, high value environment.

In total, London's population has grown by nearly 600,000 since 1989, the equivalent of a city the size of Sheffield. By 2016 it is projected to reach 8.1 million, a further increase of 700,000, and one equal to the population of a city the size of Leeds.[9]

A consequence of these flows and the inherent flexibility they bring is greater competition in the job market at all levels. In turn, this places greater pressure on London's learning providers to ensure a continuous supply of highly productive labour to London businesses, regardless of origin, and to make sure that the potential of London's communities is fully utilised.

Importance of high level skills for the people of London

London's unemployment rate is higher than the UK average, indicating that Londoners without higher level skills find it hard to enter the workforce. The demand for highly skilled workers means that a large proportion of Londoners who have no or poor qualifications remain unemployed. For example, in June 2004, the average rate of unemployment in London stood at 7.0% compared to the UK average of 4.8% and the average for South East England of 3.7%.[10]

Unemployment in London affects some groups especially severely. The GLA 2001 census report showed a huge variation in unemployment rates in London. There were very high rates for Bangladeshi and black workers - one fifth of Bangladeshi people active in the labour market were unemployed. Unemployment rates for black people ranged from 12.3% for the Black Caribbean group to 17.6% for the Black/Other group. In contrast, Indian workers had relatively low unemployment levels at 5.9%.[11]

Academic results also have an unequal distribution amongst London's diverse population. For example, the 2001 census indicates that Black Caribbean men were the least likely of all men to have a degree or equivalent qualification. Higher than average unemployment is not confined to some minority ethnic groups. In parts of London, the unemployment levels of white men is also high – a reflection of deep-seated economic and educational problems. Many women also face barriers in becoming economically active.

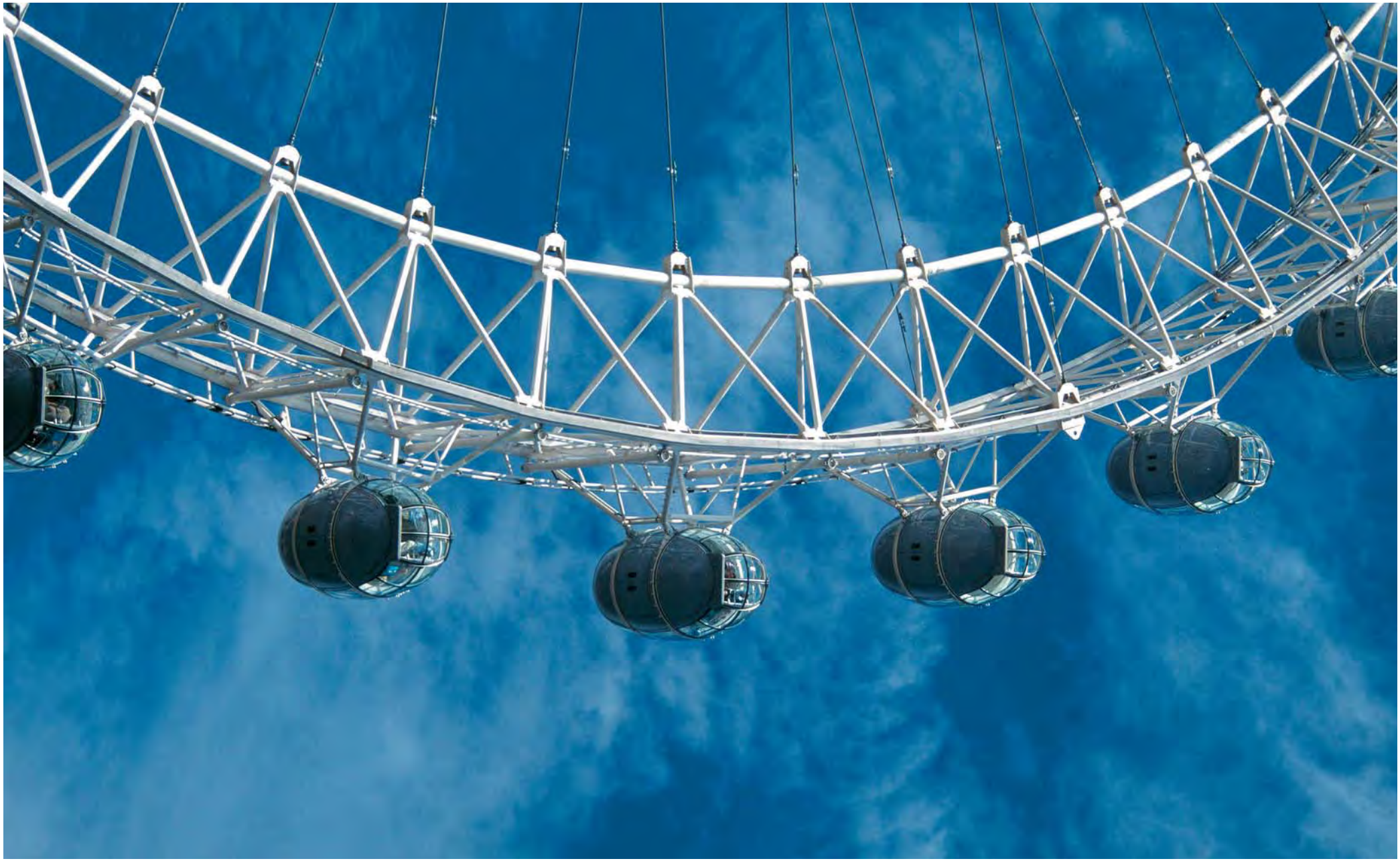
Whilst unemployment remains high in parts of London, London has been very good at creating jobs. In the final quarter of 2003, year on year employment growth stood at 1.7%, higher than the UK average of 1.2% and that of the South East region.[12] But the competition for high value jobs, coupled with the limited supply of mid-level occupations, has meant that low-skilled workers often find themselves either confined to low paying careers with few prospects for progression, or marginalised from the labour market entirely. The National Employer Skills Survey shows that only 12.4% of London employers are willing to tolerate basic numeracy amongst their managerial, professional and associate professional staff, with 61.3% demanding an advanced or high ability. In general, most employers now demand higher-level skills and these are increasingly important to career progression.

The economic uniqueness of London derives from its position as the key driver of the UK economy. It is Europe's greatest financial centre and is rivalled only by New York and Tokyo. It is also different from other UK cities by virtue of its sheer scale, the diversity of its economy and its people, and its attractiveness as a location for global business. London is the economic powerhouse of the UK.

Productivity levels in the UK are low in international terms. In 2002, productivity levels in the UK were 31% lower than in the US, 14% lower than in France and 3% lower than in Germany.[4]

Yet London bucks this trend. The exposure of London to overseas competition and foreign investment forces businesses in the capital to drive up their performance. London's need to compete on an international stage results in it having productivity levels some 25% higher than the national average, and these are 45% to 50% higher in the financial services sector.

The competitive position of the UK economy as a whole is inextricably linked to the competitive position of London; if London's productivity and competitiveness suffers, so does that of the rest of the UK.



The STEM skills gap: The picture in London

The job market: Are employers getting the skilled workers they need?

Evidence of a London skills gap

Sector trends for London reflect those of the UK as a whole: bioscience, pharmaceuticals and other high technology sectors are expected to be growth areas, but there is already evidence of skills shortages in the capital.

In 2002, figures showed that 19% of engineering employers in London had hard to fill vacancies, estimated at around 580 hard to fill vacancies in total.[13]

Other figures show a total of 15% of businesses in London reporting a gap between the skills of current employees and those needed to meet business objectives. Skills gaps for technical engineering skills (76%) were the most significant, followed by key/personal skills (11%) and general IT/computer skills (5%).[13]

The engineering Modern Apprenticeship has the largest number of apprentices in training of all sectors in the economy, but the SEMTA prospective workforce development plan for the sector estimates that there is a need for an entry of 10,000 apprentices per year, compared with the current level of around 6-7,000.[13,14]

The situation with Information and Communication Technologies (ICT) is similar. The ICT sector accounts for 5.2% of Greater London's employment, and 23% of the total UK ICT workforce is in London. The importance of ICT and electronics in all sectors means that there is an increasing demand for graduates and sub-graduates in these disciplines across the whole economy. London's ICT workforce of around 274,000 is the largest to be found in any UK region.

The proportion of companies expecting growth in ICT professional employment in London is lower than in the UK as a whole, with 22% (UK = 23%) of companies planning to expand their ICT workforce. The proportion of companies expecting to shrink is larger than the national figure, at 17% compared to 12%. When the actual numbers of professionals in these companies is taken into account, the net change in employment in the region is predicted to be 2.5% shrinkage. Demand is greatest for Training Professionals, Software Development Professionals and Systems Administrator/Operations Specialists.

In London, where almost a quarter of the country's ICT professionals are employed, serious skills gaps are reported by a high number of employers. Despite expectations of shrinkage, some employers are experiencing difficulties recruiting appropriate staff. 63% of employers in the region report that their ICT professionals need additional skills. This is much worse than the figure for 2002 (49%) and for the country as a whole (57%).

The GLA's London Innovation Strategy and Action Plan also points out that the potential of all the capital's population, especially women and economically disadvantaged groups, is not being harnessed in the creation of innovation and knowledge.[15]

Skilled labour is increasingly being drawn from overseas

To meet a shortfall in skilled labour, London's economy imports an increasingly large proportion of its workforce. During the period of economic expansion from 1993 to 2000, many of the 700,000 new jobs created were filled through a 525,000 net increase in inward international migration. (This is alongside a high level of inward migration among the UK's young professionals, who find the economic and social advantages of London extremely attractive.) These international flows mean that just over one in four of the population of England and Wales born outside the UK live in London, and just over 28% of Greater London's population were born outside the UK *Source:* Country of Birth and Labour Market Outcomes in London, Lorna Spence, DMAG January 2005.

It is clear that the influx of highly trained labour enables London business to be more selective in whom they employ than elsewhere in the country. The 2003 National Employers Skills Survey[16] shows that only 16% per cent of London employers said they had internal skills gaps compared with 22% nationally. The region also had a lower proportion of hard to fill vacancies (29% of all vacancies compared with 40%).

Employers we interviewed said that they, and other companies operating within their sectors, are increasingly looking to recruit from overseas. This includes from Commonwealth countries, as qualifications are transferable and recruits often come with several years' experience. In the pharmaceutical industry, EU graduates are attractive since, in the experience of the employers we interviewed, they often have superior laboratory skills because their degrees have more of a vocational element. There are real opportunities here to link into the Refugee and Asylum seeker Flagship actions to recognise or update overseas qualifications and provide other support for migrants entering the labour market at managerial levels.

Training

Research shows that employers also experience difficulties in providing their employees with skills through training.

The most frequently mentioned barriers to training were employers being too busy or lacking available time (11%), employers not being able to afford to have staff take time off for training (7%) and the cost of training locally (7%). To overcome these difficulties, the most frequent suggestions from employers were: further subsidies or grants from government (8%) and more assistance with funding for courses (8%).[13] 51% believed that nothing could be done.

Table 1: Employers' most mentioned barriers to training

Employers too busy	11%
Employers can't afford to give staff time off	7%
Cost of training locally	7%

Source: EMTA Labour Market Survey of the Engineering Industry in Britain.[13]

Table 2: Employers' most frequent suggestions for overcoming training barriers in London

Nothing Can be Done	51%
Further subsidies or grants from government	8%
More assistance with funding for courses	8%

Source: EMTA Labour Market Survey of the Engineering Industry in Britain.[13]

Many STEM employers offer work-based training to new recruits. In traditional engineering, for example, new graduates undertake structured training, leading to Chartered Engineer status. This training is focused on the needs of the company but is certified by a Professional Institute (such as the Institution of Civil Engineers). In addition to the work-based training element, the instruction consists of formal health and safety training, and training in project management, team work and technical skills.

In other industries training might not be as formalised and smaller companies often rely on external training providers. In electronic manufacturing at Texcel, for example, skills gaps are filled through external training courses at a local college or university. Only those people working in the less skilled roles are trained in-house.

External training is, however, of variable quality and many companies saw a need to develop the capacity of providers to support industry-relevant training and enhance its employer focus. STEM industries tend to be fast moving, and there is a need for continuous investment in training to maintain competitiveness.

Smaller companies in particular said that they struggle to make this investment. They see a need for more training grants and clearer application procedures to enhance their accessibility. At present, most grants are only available to third parties rather than to employers themselves, to ensure transparency. Employers interviewed as part of this research felt that this can result in inappropriate and poorly focused training.

International scientific meetings also provide useful training opportunities. However, such meetings are very expensive for delegates and there are rarely concessions for small companies.

It is not only technical training that STEM employee's need. A variety of other skills gaps have been identified including: ICT skills, particularly statistics programmes, PowerPoint and Excel; literacy and report writing; numeracy; soft skills, including time management and team working; and general knowledge of STEM industries and business environments. At present, there is a requirement that many courses lead to a recognised qualification. This is not always appropriate, and employer needs would be better met by the introduction of more flexibility in external training courses.

Recruiting into STEM industries

Whilst there is a wide diversity of STEM industries and STEM jobs available, recruitment difficulties prevail. Employers we interviewed cited problems in paying competitive wages as a major cause. Lower added-value manufacturing industries and STEM Small and Medium-sized Enterprises (SMEs) in particular said that they were unable to compete for the best recruits.

Employers say that returners to STEM represent a promising potential source of new recruits. However, some of the employers we interviewed pointed to real problems of a rapid loss of expertise in people who have left a specialist sector, and who can no longer carry out their old jobs effectively.

The London Biotechnology Network

The London Biotechnology Network was formed by London First on behalf of the LDA in June 2000 to co-ordinate biotechnology development in London. It is the largest regional biotechnology network in the UK with some 800 member organisations. LDA activities relating to the network include developing new incubator and laboratory facilities for biotechnology companies. The LDA-funded London Bioscience Innovation Centre is now open and houses a number of companies, offering them economies of scale and encouraging small companies to locate in London.
www.londonbiotechnology.co.uk

Employers felt that in manufacturing there was a rise in the number of people leaving the sector: semi-skilled staff can earn as much in a less demanding job, while the more skilled, numerate employees may be offered better employment packages in other industries. Factors in this may include the poor image of manufacturing compared to other occupational sectors, inability (or unwillingness) of businesses to pay a competitive salary, and possibly the relatively demanding nature of particular jobs in STEM industries compared with those in other sectors. This will clearly not be the case for all sectors that depend on STEM skills, and particularly among the high-end companies, but is indicative of trends across the family of STEM industries.

Group Training Associations (GTAs)

There are now 88 Engineering Group Training Associations serving approximately 16,000 companies, employing over 1 million people. GTAs were originally set up to help SMEs with their engineering training needs, and had strong links with Industry Training Boards and engineering companies in their localities. They have diversified. While most groups still have core engineering company membership and have maintained their engineering expertise, their scope is much broader. They offer a wide range of training provision and services, mainly to SMEs, including NVQ assessment, advising on workforce development and analysing training needs, providing health and safety training and guidance, and management training, within a very tight financial regime. They are funded chiefly by employer subscriptions. Currently there is one GTA in London, Inner London Training.
www.semta.org.uk, **www.ilt-training.co.uk**

Advertising STEM jobs

The employers we interviewed used standard methods of recruitment including advertisements in trade journals and national newspapers, web-based campaigns and contact with educational institutions, employment agencies and Jobcentre Plus. Many of the large employers also receive CVs on speculation. Employment agencies and consultants are widely reported to offer a variable and expensive service. This opens up opportunities for London's publicly funded access-to-employment infrastructure to support access to STEM employment, plugging a potential gap in the market.

Communication between business and learning providers

Most companies we interviewed would welcome more opportunities to network with learning providers. Benefits were seen to extend to both sides - businesses can exert influence on the structure of courses, and students can learn more about the opportunities available and gain access to role models and work placements.

However, at present, as the IFF Report on employer needs in London has noted, links between employers and learning providers are very patchy. The report apportioned blame to both sides: colleges had little time to undertake this work and often saw it as a way of marketing their courses, while employers, especially SMEs, were unwilling to participate. One college had instituted an annual review of its planned prospectus with local employers, but this was an isolated example.[17]

The New Engineering Foundation report found that although the UK industrial focus has shifted, most engineering Further Education (FE) has not changed. For example, many FE colleges had an overwhelming focus on City & Guilds Certificates, whereas industry requires higher level technical skills such as NVQ (National Vocational Qualification) level 4 and HNC (Higher National Certificate). A high proportion of FE colleges offered courses linked to car engineering, reflecting the industrial needs of the past when the UK had a large car industry. The report concluded that FE colleges needed to focus on current and future skills required by industry.[4]

The Professional Institutes offer valuable feedback and often run industry seminars. The Civil Engineering Council, for example, provides feedback to education providers, and works with WISE (Women in Science and Engineering). Many employers told us that they would be willing to contribute to awareness schemes, providing that they were thoughtfully set up.

Employers often lecture at local universities and colleges. This allows them to meet students and to help challenge pre-conceptions and encourage dialogue. This is seen as a valuable method of recruitment, mainly for smaller companies, particularly when students have undertaken practical placements at an employer's premises.

Communication between business and policy makers

Many employers we consulted felt strongly that there is a need for much greater relationship building and networking between businesses and policy makers, and that services and assistance should be streamlined. Jobcentre Plus, Learning and Skills Councils, the LDA and the Small Business Service, amongst others, should all work more collaboratively to cater for the needs of STEM industries. Establishing the correct role and function of the new Regional Skills Partnerships, which are gradually being set up throughout the country, will be important in improving co-ordination between business and policy makers.

Employers also expressed fears that there is a "scattergun" approach to funding provision, with too many poorly targeted schemes. If available funding was made more accessible, better advertised and deployed more flexibly, the value it could add to the quality of the labour force would be significantly enhanced.

Higher Education (HE)

If there are current gaps in STEM skills, what are the prospects for the future? The numbers of students enrolled on STEM courses (covering biological sciences, physical sciences, mathematical sciences, computer sciences, engineering and technology) in London's universities presents a more positive picture, with figures published in 2004 showing that 30% of all enrolled students are studying STEM subjects.[18] This 30% consists of:

Table 3

First degree enrolments	50.7%
Other undergraduate level study	22.7%
Postgraduate taught	17.1%
Postgraduate research	8.1%
Further Education level	1.4%

Source: London Higher: London, the Knowledge Capital[18]

72% of STEM subjects studied are medicine- or biology related, with the remaining 28% physical sciences, mathematical sciences and technology.[18]

Interestingly, 50% of those studying STEM are aged over 25, with 21 to 24 year olds accounting for 25.2%.

The attractiveness of certain STEM study areas varies according to gender. 60% of those studying STEM are female. The majority of students of medicine, dentistry, biological and veterinary sciences are female, while most students of physical sciences, mathematical sciences and engineering and technology are male.

According to the 2002/2003 Higher Education Statistics Agency student returns, the number of students studying STEM sciences in London's Higher Education institutions was as follows:

Table 4

Science	Postgraduate: 38,880 Undergraduate: 112,240
Engineering and Technology*	Postgraduate: 6,265 Undergraduate: 13,090
Mathematical Sciences*	Postgraduate: 810 Undergraduate: 4,170

Source: Higher Education Statistics Agency 2002/2003
(*These subjects are included in the totals for Science)

Across the UK as a whole in 2002/2003, however, 27% of all students studying engineering and technology, and 17% of all students studying mathematics, were from overseas. These figures are higher for postgraduate courses - 37% of taught postgraduate students were from overseas, and 35% of students taking research degrees were from overseas. These percentages are likely to be higher in London.[19]

SEMTA Sector Strategy Groups

There are 13 SEMTA sector strategy groups focusing on different industrial sectors. Each group is made up of employers and employer representatives and they are a focus for discussion on skills issues and productivity. Each contains a vertical slice of major and small employers, usually represented by the managing director. The groups are chaired by an elected member.

There are four groups in particular that are working as part of a demand-led pilot approach laid down in the sector skills agreements. These are aerospace, automotive, electrical and bioscience groups. Data gathered by SEMTA on skills provision gaps and actions is filtered through the SSGs (Strategic Study Group). A further group feeds into FE/HE, currently predominantly on bioscience and forensic science.
www.semta.org.uk

Schools and Further Education

The picture among students aged 14 to 19 in schools and FE colleges is more worrying. Of particular concern for all sectors in science, engineering and technology is the steady decline in the number of A-Level passes in mathematics and physics.[20]

The number of students who have potential to progress in STEM post-16 depends chiefly upon their performance in their school or FE college years, and also upon their experience of STEM teaching. The quality and level of available STEM study options is therefore very important.

The SETNET National STEM Database[21] is a unique dataset which is intended to influence strategy and planning for STEM at both a national and regional level. It analyses data by region to identify strengths and weaknesses in STEM provision and performance, and enables comparisons to be made. The Database statistics chart the level of STEM activity, and the standard of pupil performance, within London's schools in comparison with the rest of the UK. It shows:

- a 9% drop in the number of schools engaged in STEM activities between 2001/2002 to 2002/2003, compared with a 17% rise in Scotland and an 11% rise in the East Midlands
- in 2002/2003, 35% of schools and City Technology Colleges in London were actively engaged in activities promoting STEM, compared with 79% in Scotland, 59% in Wales, and 51% in the East of England
- there was a 10% drop in all pupils engaged in STEM activities between 2001/2002 and 2002/2003 – from 23% to 13%
- whilst London's 2002 Key Stage 2 SATS performance reflects the national average, Key Stage 3 performance in science and mathematics, at 29%, is significantly below the national average of 33%, and lags well behind the South West's total of 36%
- whilst A Level results in STEM have improved over the last three years, all London's STEM GCSE level results are below the national average. From 2000/2001 to 2001/2002 figures for students achieving a grade C or higher declined from 44% to 41% in mathematics, from 43% to 39% in science and from 36% to 33% in technology.

SETNET considers the performance in mathematics to be particularly worrying. Mathematics skills are commonly needed in the workplace and are essential for those working in science, technology and engineering.

Specialist schools are a crucial element in increasing the take-up of STEM subjects, offering opportunities to focus upon intensive, high-level support in specific areas. However, the availability of such schools in London is poor - only 168 of 413 schools have specialist status. Only 49% (83) of these received their awards in technology, science, mathematics or computing, and only four schools specialise in engineering subjects.

At the Further Education level in London, 96.2% of STEM study enrolments for 2002/2003 are at Level 3, with only 3.8% for Level 4 and above. This may be one of the causes of the lack of higher level skills in engineering quoted by SEMTA.

Conclusion – the outlook for London and STEM skills

SETNET's findings on the study of STEM in London, quoted above, suggests that the capital's ability to motivate school pupils to excel in STEM studies, particularly at the key Stage 3 and GCSE level, is poor. In addition, the level of initiatives to promote STEM within schools in London is lagging behind other regions. FE STEM study is generally topping out at Level 3.

The capital appears to be better at attracting people into STEM at Higher Education level. It is important, however, to recognise that the relatively high numbers of university students involved in STEM in London will include students from beyond the capital.

There is a high level of interest in studying STEM subjects at Higher Education level in London. But London has the lowest numbers and percentages of employees in the high and medium-high technology industries of all United Kingdom regions including Wales and Scotland. Between 1998 and 2002 the London medium and high technologies sector showed a 25% decline[47] from 74,000 to 57,000 employees. However, this figure needs to be put into the context of a decline in all of the UK from 1.5 million to 1.2 million.

The total percentage of employees in this sector in London was just 1.5%, compared to 6.5% in the North East and 5.4% in the South West. However, as these statistics include employment in manufacturing activities, such as the production of semi-conductors, they will be lower for London, which does not have a large high and medium technology manufacturing sector.

Overall, when looking at employment trends in the medium and high technology sectors in London, it appears that much of the specialist knowledge acquired in London at the Higher Education level leaks from the capital to the rest of the UK. In addition, as SETNET points out, the market for graduates is international, and many UK graduates gain employment overseas.

Numbers and percentages of employee jobs in the high and medium-high technology industries

	GO Region/Country													
	UK1	NE	NW	Y&H	EM	WM	E	L	SE	SW	ENG	WAL	SC	NI[2]
							Levels							
1998	1,518,543	75,235	189,401	114,476	129,332	218,744	147,063	74,619	214,272	129,354	1,292,496	77,273	116,574	32,200
1999	1,462,529	68,325	186,869	105,652	119,263	204,618	129,964	77,058	218,385	125,860	1,235,993	81,056	113,680	31,800
2000	1,439,284	68,355	180,500	104,865	113,069	192,361	138,943	75,462	211,158	126,758	1,211,470	78,394	114,919	34,500
2001	1,375,642	65,075	177,032	101,637	109,826	183,857	136,228	68,520	192,707	124,123	1,159,005	71,301	110,836	34,500
2002	1,278,672	64,901	163,347	95,619	102,765	176,180	129,999	57,290	183,335	112,899	1,086,335	69,057	90,680	32,600
							Per cent							
1998	6.1	8.0	6.8	5.6	7.4	9.6	6.7	2.0	6.3	6.6	6.1	7.4	5.4	5.2
1999	5.7	7.1	6.6	5.1	6.9	8.9	6.1	1.9	6.1	6.3	5.7	7.6	5.2	5.1
2000	5.6	7.1	6.3	5.0	6.5	8.4	6.2	1.9	5.8	6.2	5.5	7.2	5.1	5.4
2001	5.3	6.7	6.1	4.9	6.3	7.9	6.0	1.7	5.3	5.9	5.3	6.5	4.8	5.3
2002	4.9	6.5	5.5	4.5	5.9	7.6	5.7	1.5	5.0	5.4	4.9	6.3	4.0	4.9

Source: Regional Competitiveness and the State of the Regions, Dti, 2004[47]

Some reasons why STEM-related careers in London can be unattractive

High living costs

London is an attractive place to live, study, work and establish a business. London is a vibrant world centre, its universities boast national and international centres of excellence in research, teaching and technology, and it is home to the seat of the UK Government. London's high productivity also adds a premium to work experience gained in the capital.

However, London is an expensive city and the high cost of living is deterring some students from pursuing postgraduate STEM study. Research conducted in 2003 showed that the cost of living in London was 17% to 20% higher than in Edinburgh and 23% to 30% higher than in Manchester.[22] London's growing economy and population have led to an increased demand for housing, which has not been matched by adequate supply. From the first quarter of 1995 to the first quarter of 2002, house prices in London rose by 149%, compared with 87% for the whole of the UK.[22]

Our primary research among young people revealed that the high costs of studying in London has resulted, in many cases, in students from London-based households cutting costs by staying at home (London) during their college and university years, and often after graduating. This trend is likely to increase with the restructuring of Higher Education funding and the added financial cost this places upon the student.

It is reasonable to assume that the high costs of studying in the capital limit the attractiveness of London to students resident elsewhere in the UK. However, London remains attractive to foreign students, especially in view of the difficulties many face in studying in the USA post 9/11. With the accession of 10 new countries to the European Union (EU) in 2004, London is also now more affordable and attractive to students from central and Eastern Europe.

For students the transition from student life to full time employment, with the associated loss of exemptions from council tax and travel reductions, increases these cost-of-living pressures. This might have adverse implications for those seeking to enter and continue postgraduate STEM studies. The level and depth of skills required for STEM jobs require long periods of study, increasing student debt. According to our primary research, this has deterred students from pursuing STEM study and careers.

The land premium in London creates high premises and overhead costs for businesses, making it a difficult environment for many SMEs, especially those with national or international competitors. It also has an impact on the capital's ability to attract and retain key workers, including teachers and health professionals, who are vitally important for STEM education and employment. The key worker housing home-buy scheme in London addresses this problem.[8]

London's wage premium

STEM businesses, especially in the traditional engineering and manufacturing sectors, claim that they need to offer higher wages than in other parts of the country (both to compensate for the higher cost of living and to compete with high-paying city firms). Our research has found, however, that the London wage-premium in some STEM industries is generally lower than in the UK as a whole.

The New Earnings Survey[23] indicates the hourly pay rates (excluding overtime) for occupations in London, and how these compare to the UK average. The differential exhibited within occupations in more traditional STEM industries is narrower than in other occupations, reducing the attractiveness of London as a place to work in STEM in comparison with the rest of the UK.

Key features of this summary are: the significantly reduced differential between teaching, research and health professionals and corporate managers and business and public service professionals. In the case of teaching and research professionals this is not restricted to STEM, and possibly contributes to the teacher turnover rate of 20% in inner and 18% in outer London.[22] Our primary research shows that overheads to businesses in London often limit the flexibility of STEM SMEs to offer the competitive salary packages required to attract and retain high quality staff.

Table 5: Wages by occupation 2003

	Difference in hourly pay between London and UK		
	Full time workers	Male full time workers	Female full time workers
Health Professionals	-0.1%	-2.1%	1.7%
Teaching and Research Professionals	6.6%	6.9%	6.1%
Science and Technology Professionals	12.3%	12.4%	15.2%
Skilled Metal and Electronic Trades	17.3%	16.8%	36.6%
Managers and Proprietors in Agriculture and Services	18.3%	15.2%	28.8%
Transport and Mobile Machine Drivers and Operatives	20.8%	20.4%	36.6%
Corporate Managers	28.0%	30.4%	30.3%
Business and Public Service Professionals	34.1%	32.1%	39.5%

Source: Reference 44

Some STEM-related industries are increasingly dispersed

STEM skills-dependent industries in London are often hidden, with technical operations frequently dispersed and based outside the urban centre. This makes it harder for potential employees to spot career opportunities. It also makes business networking or collaboration with learning and skills support agencies difficult.

London's continued economic performance depends upon clusters of knowledge-intensive, specialised industries, a flexible and skilled workforce, and a large concentration of research activity along with a history of innovation and product development. STEM employers we interviewed for this report value the potential opportunities represented by the proximity of the cluster of major Higher Education institutions within the capital, offering ready access to students requiring work placements or long-term employment.

However, some London companies reliant upon STEM skills and knowledge, including electronics manufacturers, are located outside the UK's main centres of technology-based industries and, as such, are beyond the pull that clusters can exert upon potential recruits. This reduces the pool of skilled potential employees available locally.

Spatial considerations

In terms of the location of STEM industries, the sheer scale and diversity of London and a lack of clustering in some STEM industries means that some of these industries and jobs are hidden and are distributed widely across London. This also means that there are fewer opportunities for interaction between STEM businesses and the broader STEM support infrastructure including learning providers.

For example, there are relatively few businesses in the heavier engineering and technology STEM sector in central London. STEM SMEs in particular are often based in the suburbs, while large companies often have their headquarters in London, but not their wider industrial operations. SEMTA and SETPOINT (see Appendix 4) confirm that this presents difficulties in identifying STEM employers and employment opportunities. It also reduces the number of role models available to inspire students in their local community. It results in a relative shortage of science ambassadors available to visit schools, and it makes it more difficult to find work experience or arrange visits for students.

It is equally difficult to identify the many 'hidden' jobs for scientists and engineers in London in the wide range of companies that are not conventionally considered to be dependant upon STEM skills for their competitiveness - for example within the broadcasting or creative and design sectors.

Transport was also found to be a factor in STEM employment. Proximity to high population catchment areas is a key location-specific factor for business in London. Whilst transport routes from the centre to outlying districts are adequate, radial routes are generally poor. This limits the employment base accessible from specific business locations.[22]

Equally, the variable quality of transport routes presents logistical difficulties for business and cross-sector networking. Our primary research shows that poor transport links result in poor communication between the agencies and institutions in London that have a remit to improve STEM skills provision. This means that best practice is not shared, and it is harder to scale up initiatives to gain critical mass.

Negative perceptions of STEM subjects among young people

Why it is important to excite young people about STEM subjects

If Londoners are to contribute to the growth and prosperity of the city that they live in, it is vital that they understand what exciting careers are available using STEM skills - careers that can make a real difference to people's lives. People in London, and particularly young people in London, should all have the opportunity to share in London's high-skilled, high-productivity future.

The public image of STEM: The role of the media

The negative public image that many young people have of STEM subjects and scientists is partly based on a lack of knowledge and the failure of the media to promote the positive aspects of STEM.

Our interviewees offered a variety of viewpoints about science as a subject and their image of those who study and practice it. Some young people enjoy STEM subjects and careers, describing them as challenging, constantly changing and presenting exciting possibilities for the future. Many value the opportunity they offer to make a real difference in the world:

"Engineering is a cross over between art and science… you're creating something new".

Other young people, however, had a less flattering opinion of science and scientists. Scientists were described as "boffins, cranks, strange, old, boring and unsociable". The stereotypical image of a bespectacled white-haired old man was shared by many.

"When I tell people I want to do physics at university they're like, oh, you're going to be one of those people with big scruffy hair and glasses in a lab all day. Geeky…working on equations, cut off from the real world, no social life".

This negative stereotyping starts at an early age in secondary education. A survey of secondary age children found that among the most "evil" were mathematics (25%) and science (20%) teachers, and the most boring teachers were in mathematics (17%) and science (20%).[24]

STEM subjects were perceived by a number of young people we interviewed to be difficult, technical and complicated rather than exciting or fun.

"…boring, too theoretical, irrelevant, impractical, too difficult – and too much like hard work!"

These views are given added credence by the House of Commons Select Committee on Science and Technology. In 2002 it reported that students thought that coursework for science A-levels was more difficult than for other subjects such as business studies. It also found that students thought that it was more difficult to achieve an A grade in some A-level subjects, including STEM subjects, than in others.

The Committee concluded that students may be put off studying science at A-level if they think it will be harder work than other subjects. However, there are limits to how far the teaching of STEM can be made easier. To progress in STEM subjects, there is a need to master a considerable body of knowledge.

Other research suggests that young people give the following key reasons as to why they do not want to continue taking STEM subjects.

- Want to work with people instead of things.
- Want to earn lots of money.
- Want an exciting job - science isn't it.
- Creates problems for society – it's destructive and dangerous.
- Most suitable for males.
- Difficult to understand - not intelligent enough.
- Unsociable career.
- Boring and dull people and career.
- Too expensive to study at university as can't have a part time job.
- Too many hours of lectures, want a life.[25, 26, 27, 28, 7, 29, 30]

Picture of scientist drawn by 13 year old English boy

Employers in particular expressed regret that the media presents science less positively than other disciplines. Wildlife documentaries may be popular, and architecture and design programmes capture the imagination of many. But the focus in these programmes is often on aesthetics, and the significance of life sciences, mathematics and physics tends not to be recognised as central to these subjects. An exception quoted by one interviewee was the popular episode of the BBC 'If' series ('If... the lights go out'), which was based on the 2002 State of the Nation report on energy by the Institution of Civil Engineers.

A parallel can be drawn with the resignation in September 2004 of Sir Terence Conran and the inventor James Dyson from the Board of London's Design Museum. They both felt that the museum was concentrating too much on the externalities of design. Their reported reasons for stepping down were that they wanted the museum to show that design was about manufacturing and engineering as well as about art. They felt the museum was doing too little to promote interest in technology and industry.[31]

Our interviewees felt that the significance of STEM disciplines was rarely discussed outside specialist publications. There is a broader issue at play here, as the connection between science and everyday life in the modern world is often either taken for granted by the media or seen as too complex to explain to the general public. This was not helped when in 2002 the BBC's long-running science programme 'Tomorrow's World' was scrapped.

In biological disciplines, one employer interviewee believed that a poor media image made it difficult for scientists to gain pharmacological experience. The scientific research and pharmacology employers we consulted both pointed out the harm this may cause to business competitiveness in the UK, giving examples of research plants and researchers moving overseas.

A poor image of science and of its role in improving our lives, and poor communication of key science issues, can seriously undermine London's competitiveness in STEM sectors. This in turn can have a harmful effect upon the capital's employment base.

Promoting STEM and taking actions to improve the public image of science contrasts strongly with the situation in the arts. The arts have a dedicated public body, the Arts Council, with an annual budget of over £178 million. In contrast, the spend by Government on the promotion of science is spread around a number of Government departments and other organisations. The Office of Science and Technology's Science and Society budget, designed to promote public confidence and engagement in science, will only amount to some £9 million in 2006/2007.[5]

The promotion of STEM seems to be carried out in an un-coordinated manner by a large number of agencies and institutions. At present, organisations such as the Royal Institution, with its Christmas lectures, the BBC with its Science Years, the British Association, with its National Science Week, and the Royal Society, with its Sc1 programme, all have their own approaches to the promotion of science to young people. This does not send out a coherent science message.

STEM, and scientific progress, have long been viewed with a degree of suspicion by the general public. But STEM is central to solving environmental problems and curing disease, for example. More prominent and positive media coverage, which promotes the importance of STEM in solving real-world situations, could help put STEM study and career options on the radar of young people.

However, perhaps science also needs to be more honest about its own failings. The UK public is not alone among developed countries in having a negative view of science. Sjoberg's international SAS study of attitudes to science and scientists concluded that a poor media profile and bad teaching could explain this. But the study also suggested that many young people have a sceptical but well informed attitude towards aspects of modern society, including science.

Science Learning Centre London

The national network of Science Learning Centres, including one in London, will act as a catalyst for creating inspiring, intellectually stimulating and relevant science education. By mixing together teachers, technicians, advanced ICT, cutting-edge scientific thinking, industry expertise and high-quality professional development, they provide the conditions for innovation and inspiration. Teachers and technicians will be able to use the Science Learning Centres to gain support and expertise in delivering science education that gives students the knowledge and understanding they need - both as scientists and citizens of the future.
www.sciencelearningcentres.org.uk

As one girl put it in the study, "scientists do things to make our life easier but sometimes do more damage than good".[32] If this latter explanation is true, then it indicates that science should be debated maturely as well as simply promoted.

Perceptions of STEM careers

Young people and those who influence their choice of study and career are often unaware of the full diversity of STEM careers and the range of opportunities they offer. STEM employment is associated by many young people with poor pay, hard work and long hours, not with high technology industries which can offer well-paid and secure employment.

Young people, employers and employees of institutions that we interviewed were unanimous that STEM professions suffer disproportionately from negative stereotyping when compared to other disciplines. Those involved in helping young people make career choices do not appear aware of the breadth of STEM careers available, and the potential rewards they offer in comparison with other professions that are more highly valued and regarded. In particular, the career pathways open to those with STEM-related skills and qualifications within sectors not traditionally associated with 'science' lack visibility and are commonly unrecognised.

Our research has shown that the promotion of STEM study and careers needs far greater and more professional advocacy. It should convey more accurately the rich mix of interesting and rewarding study and career options available, and also show that high value professions such as banking and psychology, and innovation in many fields, is undertaken and underpinned by those with STEM-related expertise.

Perceptions of STEM work, pay and rewards

STEM is not a single subject category, but is a combination of different, yet often inter-related subject areas. Our research showed that certain STEM careers are looked upon more favourably than others. Different levels of status tend to be attributed to different types and levels of employment, with doctors, veterinary surgeons, architects and engineers generally being perceived more favourably than workers such as laboratory-based researchers and technicians.

There was consensus among the young people and employers we spoke to that the image of engineering and manufacturing is particularly poor. The opportunities offered by high-end, high productivity engineering and manufacturing sectors, crucial to maintaining the capital's competitive edge, tend to be overshadowed by more traditional images of jobs in these sectors as "repetitive and dirty". There seems to be too little awareness of the changing nature of engineering, which now includes sectors such as biometric engineering and nanotechnology.

There is also a common belief that careers associated with STEM skills and knowledge, including research and engineering, pay badly compared with what people perceive to be non-STEM options such as the financial services and creative industries. However, these employment sectors are in fact increasingly reliant on STEM knowledge and skills.

A comment by a member of a Professional Institution representative on employment in research and innovation within the capital sums up this view:

"It's not as lucrative as other jobs in London, especially the City, or abroad, where they are given double the budget for research, academic freedom and double the pay. If industry wants good people they must be prepared to pay".

NOISE

Noise – new outlooks in science and engineering – is a new campaign to raise awareness of science and engineering among young people by making them more relevant and accessible. Funded by the Engineering and Physical Sciences Research Council, Noise includes a new web portal which includes areas devoted to Sports, Fashion, Travel and the Environment. The result is a series of articles and features which shows how widespread the influence of science is on everyday life and reveals just how broad science-based study and work can be.
www.noisenet.ws

The evidence above suggests two main areas for action. Firstly, an up-to-date picture of sectors such as engineering needs to be given to young people, so that they can be inspired by forward-looking ideas and concepts. Allied to this, there is an urgent need to make clear that STEM skills and qualifications lead not only to the more obviously STEM-specific employment, but are also of use in other higher-level occupations, including in finance and the creative industries.

Secondly, more should be made of the advantages of STEM-specific employment, drawing lessons from the ways in which non-STEM related careers are marketed and perceived. For example, the advantages of both traditional and new engineering often include flexible working hours, scope for a good work-life balance and structured training programmes. Few recognise that, on an hourly rate basis, engineers are often paid as well as those in occupations such as advertising – careers in engineering can also be much more secure.

On top of the poor image and lack of promotion of vocational routes, some students and teachers said that schools actively dissuaded their more able pupils from opting for work-based learning routes. The schools need their pupils to achieve academic results. This is especially the case if they have sixth forms, where funding is linked to enrolment numbers and the achievement of academic qualifications.

For example, an Engineering Employers Federation (EEF) representative asked a group of young people why they had undertaken apprenticeships:

" 'My dad did one' …'My brother…' Always someone in their family. And when we, the [EEF] asked 'what did the school say?' the apprentices replied 'They tried to talk me out of it'. These were the apprentices who didn't listen to their teachers. The question needs to be asked: how many more would it suit to do this route? It is imperative to stop discouraging young people".

Students at St George Monoux School Sixth Form College Networking Academy

Through an innovative partnership with Cisco Systems, the college is preparing students for the demands and opportunities of the information economy whilst creating a talent pool for building and maintaining networks. The Academy links with colleges around the world and so offers students the opportunity to study for world class qualifications alongside peers from the USA and the Far East. **www.george-monoux.ac.uk**

Careers guidance

The evidence gathered for this report shows that high quality careers advice is critical to improving recruitment to STEM. It was clear from our interviews that there is an acute lack of such guidance in STEM subjects beyond higher profile sub-sectors such as the finance industry. This was expressed particularly by young people, but also by the deliverers of projects established to redress the balance between the promotion of STEM careers and other professions. Advisors seem not to be aware of the variety of opportunities available, and lack the literature and materials to inspire and motivate young people to take up STEM careers. Furthermore, for those pursuing STEM disciplines it is hard to discover where and how to apply for jobs.

The apparent lack of promotion of direct STEM studies and careers contrasts with the over-emphasis on promoting STEM-related employment in City finance firms. Many relationships between large blue-chip finance companies and Education Business Partnerships, and other initiatives that connect recruits to the finance industry, are now mature. Close relationships between many advisors and human resource and other key staff have done much to de-mystify employment opportunities within these firms, and signpost routes into them. As a result, City blue chip companies have become relatively adept at attracting high quality, numerate graduates into jobs.

An interviewee from a Professional Institution said:

"Careers advisors and teachers are not keen to promote 'poorly paid, dirty, grubby boys' work' and are not pushing bright young men and women, especially not the work-based route."

13 to 14 year olds: A critical age group for STEM

The stage at which young people receive information about STEM is critically important. The high point in STEM interest amongst our focus group participants was widely quoted as being from 13 to 14 years of age. This was perceived to be where influence could be pivotal. However, there is a risk that, due to the problems we have discovered with careers guidance, even those who continue to study STEM beyond this may decide against pursuing scientific careers.

The influence of parents, peers and extra-curricular activities

Evidence of parental influence on our interviewees, in subject choice at A-level and university, varied. Some students claimed that parents influenced their choices only in subtle ways. However, some non-scientists pursued their career options despite very strong parental pressure to pursue STEM studies.

Some STEM subjects are looked upon more favourably than others:

"I wanted to be a doctor, my grandfather was a doctor. When I grow up I am going to do this too".

Visits to the Science Museum or knowing someone who was a scientist, doctor or engineer was also important in choice of study for some young people we spoke to.

"When I was about 9 they took us to the Science Museum and I really enjoyed it. I thought science was all about reading, and they made it really interesting, really fun. Making bubbles and shadows, I just thought it was really fun".

The Centre of the Cell

Queen Mary College is creating a hi-tech exhibition of the human body giving children a chance to see their own cells and a blood factory to look at bone marrow and stem cells. The centre, open to parents, children and the local community will act as a resource for young people wanting to make a career in medicine, dentistry and nursing, and aims to make science and medicine fun as well as educational. **www.mds.qmw.ac.uk/280901a.shtml**

The degree to which young people are susceptible to influence no doubt varies. But the fact remains that many are swayed by the thoughts and aspirations of others. This points to a need to inform young people in a balanced and positive way about the broad range of opportunities represented by STEM study and employment by, for example, targeting information and promotional initiatives at parents.

Failings in the way that STEM subjects are taught

STEM and the National Curriculum

STEM subjects are widely perceived by the young people we consulted to be more difficult, less well taught and to involve a greater workload than other disciplines. The strictures of the National Curriculum are viewed by young people, teachers and lecturers we consulted as representing a real hindrance to the quality and relevance of learning. There is, however, a tension between this view and legitimate concerns as to whether loosening the National Curriculum might lead to a 'dumbing-down' of subjects which require considerable academic rigour.

Young people, the staff of learning institutions and employers felt that there is too much emphasis on exams and assessments. This leaves little time for teachers to introduce interesting real-world examples into their teaching, so as to demonstrate the relevance of the subject. There is also too little time for pupils to go into workplaces to get a taste of the potential of STEM employment.

Young people tend to be deterred from involving themselves in external, practical applications of STEM skills due to pressure to succeed in examinations. The constant need to test and demonstrate regular, incremental achievements is seen to stifle enjoyment.

"It feels like we're cramming in a lot, everything is really focused and we have to do a lot. My teacher even acknowledged that and he said 'I know there's a lot of work but there's nothing I can do about it. You need to know it'".

But whereas school and FE college students and staff felt that there was too much emphasis on tests and hard work, Higher Education staff we spoke to thought that GCSEs fail to stretch students sufficiently to prepare them for more advanced learning. They also considered that the development of softer skills should be given more scope within the National Curriculum, through team working and independent problem solving, which are so critical to many STEM careers.

Our research shows that a greater focus on real-world applications of STEM at school might help many young people recognise the benefits of studying STEM-related subjects later in the learning process.

Teaching

The quality and motivational ability of teachers was seen as key to creating an enjoyable learning experience and to encouraging the pursuit of STEM subjects. Many young people we interviewed described how having an inspiring teacher was beneficial.

SETNET

The Science, Engineering, Technology and Mathematics Network (SETNET) promotes STEM awareness, especially amongst young people. SETNET aims to ensure there is a flow of well-motivated, highly skilled people going from schools into STEM careers, and to prepare young people for the technological world in which they live. It is a unique collaborative force of nearly 100 member organisations representing: educational organisations, institutions, professions, charities, business and industry, and Government Departments. SETNET sponsors a network of local SETpoint outlets which are 'one-stop shops' for information about STEM and a focus for initiating and promoting projects. **www.setnet.org.uk**

"I had a really great teacher…when I did my GCSE. He made it so interesting and he did some practical work and he showed us how to do it. It was fun and exciting with nice colours, and bright flashing lights. At the end of it he made it look so simple and we did it together and showed us that science isn't just for bright people, it really isn't and he taught it like everyone could understand it and get into it".

However, real concerns were expressed about the quality of STEM teaching generally, and the ability of teachers to bring their subject to life, particularly within schools. Young people, teachers and lecturers all stressed that educators need to be able to understand the viewpoint and expectations of young people, and address these in their teaching methods and choice of subject matter.

Recognition of this problem by the Government has recently resulted in the appointment of a mathematics 'tsar'. The job of the new chief mathematics adviser will be to champion the subject at all levels, from primary schools to university, and to revitalise both the practical teaching of mathematics and approaches to delivering the mathematics curriculum.

The DfES (Department for Educational Skills) Standards Unit is also a key agent in improving the quality of teaching, training and learning in FE colleges, school sixth forms and other providers in the learning and skills sectors. A number of regional teams are focusing on the introduction of new teaching and learning frameworks, and have identified priority curriculum areas. These include science, mathematics and engineering, and these will be tackled in turn over the next few years.

Planet Science

The Planet Science Outreach Programme, managed by NESTA, the National Endowment for Science, Technology and Art, has provided over £1million in support for schools throughout the UK with low levels of attainment in science. In London, this has paid for the Institute of Education to allow PGCE students to organise science-based activities designed to both motivate pupils and increase their interest and attainment. NESTA's scheme has also funded Red Hot Science, which is using popular culture such as interactive games and film to allow children to explore science.
www.nesta.org.uk

Interestingly, young people perceived that STEM teachers are too stretched to keep up with current technologies and real-world applications that would inspire them. The requirements of the National Curriculum at present make this worse and, as a result, teachers' ability to instil enthusiasm for STEM subjects is considered patchy. Four of the five London Learning and Skills Councils currently fund value-added projects, which aim to identify whether or not STEM studies are taught well at GCSE/VCE levels.

Further and Higher Education

Further and Higher Education STEM courses were thought of by many young people we interviewed as making much greater demands upon them than arts disciplines. Whilst some of the students interviewed liked the challenge of STEM, they baulked at the workload.

Young people expressed further fears regarding the relatively greater length of STEM courses and the financial consequences of taking them, given the high cost of living in the capital. In many cases, progression to PhD level was considered unattractive by young people due to the degree of difficulty and a fear of debt and over-qualification.

Financial incentives may prove a way of overcoming this. The Institute of Physics is now offering cash to entice undergraduates on to degree courses, as fears grow over rising student debt. A new scheme, announced in January 2004, aims to give means-tested bursaries of around £1000 per year to every undergraduate who studies physics in the UK, adding up to around £3000 during the course of an average degree.

Centre for Applied Science

The City and Islington College Centre for Applied Science combines the College's established Centre for Applied Optics with new programmes in forensics, sports sciences and bio-medical sciences. The forensics courses involves Metropolitan Police scene-of-crime officers contributing to the curriculum and the centre for applied Optics, which teaches part-time day release and Foundation degrees, has the support of the optics industry's leading companies.
www.candi.ac.uk

The issue of over-qualification was raised by employers we interviewed, who recognised that post-doctoral employees demand higher wages. As a result, they often prefer to employ good generalists rather than those with PhDs. Less highly qualified generalists were also preferred in some cases because graduates are more willing to undertake the bench work required for junior positions.

It became apparent from our interviews that employers frequently look only to recruit from specific universities and Further Education colleges. Some employers stated that many courses are not reflecting the needs of the market. In engineering for example there is currently a strong focus on environmental degrees but insufficient numbers of jobs for graduates. Meanwhile, there is a real shortage of civil engineers.

The engineering firms we interviewed reported that they often look to the Russell Group of universities, which they consider to produce the best quality graduates. Meanwhile, many other STEM employers look to courses with a more vocational content, since these often produce graduates who are more useful in laboratory work. Such employees are increasingly being recruited from other European Union countries, where degree training tends to be more vocationally focused.

It was considered important by undergraduates and employers that there should be more opportunities for students to gain work experience during their degree, allowing students to experience the practical application of their subjects. The employers we interviewed, including a secondee from industry charged with embedding ambassador-type initiatives within schools, strongly emphasised that students need more training in analytical techniques and placements within industry.

Employers expressed great interest in offering such placements. They said however that smaller businesses, operating towards the margins of profitability, could only offer more placements if funding support were available, to enable them to accommodate and train the temporary recruits. Without exception, the young people we interviewed found industrial placements to be of great benefit.

Some firms, particularly in engineering, do already send employees back to university to gain degrees, and offer bursaries to enable them to do this. These kinds of scheme should be better advertised to inform students about viable alternatives to funding themselves. This could help increase the pool of young people available to STEM industries.

Core skills

Many employers strongly expressed the opinion that STEM graduate applicants increasingly lack non-degree-specific skills, including general contextual understanding, communication and numeracy and logic skills. They also pointed to real gaps in literacy skills and report writing ability in particular. Research published by SEMTA supports this view.[2]

It was disturbing to note that some employers saw real gaps in the teaching of some core STEM education disciplines: mathematics and chemistry were quoted in particular.

Work-based routes to STEM skills

Representatives from Professional Institutes and employers emphasised the need to improve the image of vocational routes to higher level skills in terms of value, rewards and opportunities. This option is generally not considered by most students unless prompted. The prevailing view is that the only route into science is through university; other pathways are less obvious.

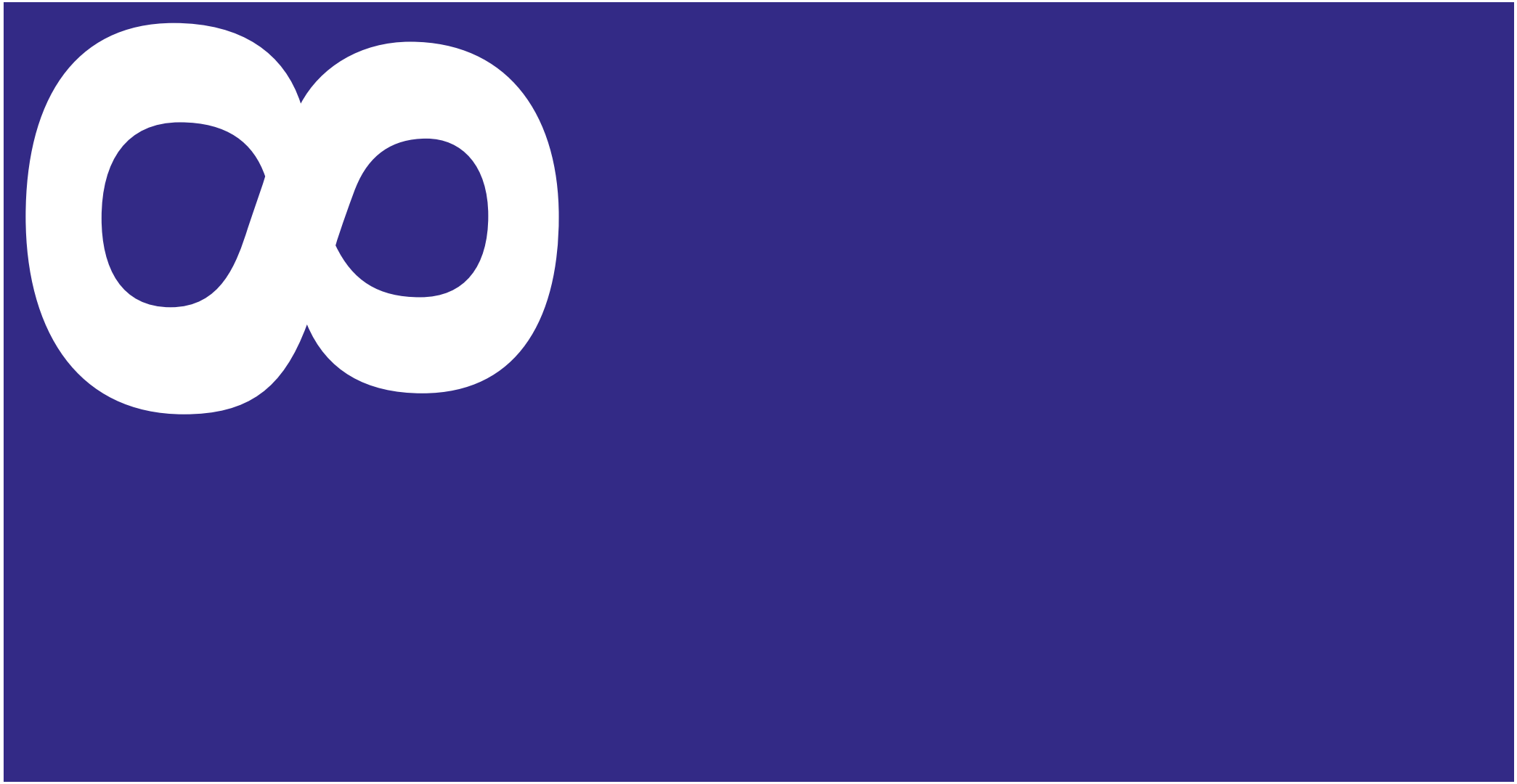
Apprenticeships have an unfortunate image as a route into STEM careers among many young people. They are too rarely perceived as a valid pathway. Also, potential apprentices perceive a shortage of companies taking on apprentices in London in STEM industries.

There was a high degree of uncertainty among our interviewees about the nature of Modern Apprenticeships. The Institute of Physics is a strong proponent of work-based routes to higher level skills, and hopes to introduce A-level students into technician placement posts as a way of opening up pathways to, and progression through, STEM jobs.

Lambeth College: Dental Technology

Lambeth College's Dental Technology Department is an example of the FE sector providing the kind of responsive training required by employers, who are closely involved in shaping course content as well as day-to-day operations. For example, one employer requested that the College halved the length of the class modules so as to give more day-release time. The course was adjusted accordingly. **www.lambethcollege.ac.uk**

Difficulties in recruiting and retaining teachers and lecturers in STEM subjects



Recruiting teachers and lecturers

Attracting and retaining good quality teachers and lecturers is a persistent problem, which Professional Institute representatives and Further and Higher Education staff we interviewed felt to be getting worse as the teacher workforce ages. The majority of science and mathematics teachers are in their fifties and will soon be retiring. This was described by some institutions as a 'demographic time bomb'.

Although teachers are often promoted quickly, graduating at 23 and often obtaining managerial posts by 30, career progression opportunities are generally not perceived to be attractive, and ambition often takes teachers away from the classroom.

London has particular difficulties in recruiting STEM teachers. Many of those interviewed said that the capital is a challenging place to teach, and the remuneration is not good compared with many other careers.

Inner city schools and FE colleges, which have discipline difficulties and often poor equipment, have particular problems in attracting good science teachers. Attracting physics teachers is an acute problem and many schools in London lack them entirely. This results in non-specialist teachers teaching unfamiliar subjects, or subjects for which they lack passion.

"London has a social deprivation problem. Learning is on the surface, not deep. Kids in rough schools are not used to concentrating. In Cambridge they were able to sit in silence and work - not here". (FE lecturer)

New Engineering Fellowship Scheme

A new scheme which aims to improve the knowledge base of lecturing staff in Engineering and Technology Departments will offer colleges the opportunity to apply for grants of £10,000 each. The grant can be used to pay for lecturers to spend a period of three weeks in industry or in an engineering and technology centre of a university to enhance their knowledge and skills in modern engineering and technology.
www.engineeringtalk.com

School and Further and Higher Education college staff we interviewed said that in London, despite London weighting, remuneration is not enough for them to remain in the profession. In particular, a widening pay gap between Further Education college lecturer and school teacher salaries is leading to a serious recruitment problem in the FE sector. Some FE colleges have to divert scarce funding from other areas so as to offer the same pay for lecturers as for school teachers. In the long run, this is unsustainable. 'Golden Hellos' for new lecturers, although also available to FE staff, are hard to resource in FE colleges. In addition, schools with higher pay scales funded by the DfES are able to poach STEM teachers from the FE sector.

Recruiting technicians in education

Professional Institute representatives and educational staff told us that there is a severe problem in recruiting technicians in schools and colleges, where starting pay is commonly around £12,000 per year. Technicians, unlike teachers, do not even qualify for key worker status as they are not regarded as academic staff. This means that they are not eligible for key worker housing.

We heard of cases where technicians are being recruited with no qualifications. For example, the head technician at Richmond College was a cleaner before he was trained. Although this can have successful outcomes, it puts pressure on the teacher who is required to carry out the training.

During 2005, the LSC will be funding the training of 10,000 school non-teaching staff nationwide, a group which will include technicians and technical support staff. It is hoped that this will provide higher quality support for the teaching of STEM. Additionally, a new career structure for science technicians has recently been recommended by the Association for Science Education and the Royal Society, which provides for a four level structure and the promotion of NVQ, Modern Apprentice and Foundation Degree training.

Some success stories: Innovative schemes, courses and competitions

A strong consensus emerged from the primary research that a number of innovative schemes are of great practical benefit in motivating individuals to pursue STEM study and careers. Examples of these schemes are included throughout this report. These include linking STEM role models with schools and colleges, creating opportunities for young people to experience the STEM work environment, and meet people involved in STEM areas. They raise students' awareness of possibilities they have never previously considered, and give them new and different choices.

"I was at a course and I met some engineers who came from the car plant. They told us what to do and it was, like, cool".

Imperial College's Pimlico project

Students work in local schools one afternoon per week to promote pursuit of higher level studies. Since 1975, the scheme has grown from strength to strength and over the last three decades, student tutors have become highly valued members of the school community. Each year over 100 volunteers take part in the scheme and during the 2002 -2003 academic year 18 schools received Imperial College students. The success of the Pimlico project led to the Ambassadors scheme being rolled out across the country by SETNET.
http://www.imperial.ac.uk/pimlico/

Young people were particularly positive about the potential of role models to encourage students to study or pursue careers in STEM:

"I think there's something about role models, recent role models, scientists, the new generation want to be cool. They want to do things like the role models do. Like David Beckham, everyone wants to play football. But it'll make them think 'why not do science?'".

However, SETNET, initiator of the Ambassador Schemes which introduce role models into schools and organise student visits to companies, told us that they have been hard to run successfully in London for the following reasons.

- Corporate HQs are often in London, and STEM headquarters staff are often account and business managers, no longer actively involved in engineering or science. In addition, fast track promotions in London often undermine any long-term relationship between schools and business.
- Transport problems - mentors are generally limited to working with local schools within a 15 minute walk. There is a perception that greater distance takes too much out of their working day.
- Dispersal of SMEs - it is difficult to reach and engage with engineering and science SMEs in the suburbs. Time away from the business is at a premium, particularly for small businesses, and the added burden of coming further into London, particularly in inner city areas, is seen as a further predicament.

The positive impact of role models on young people suggests that the obstacles to the more widespread use of the SETNET Ambassador Scheme should be tackled. The scheme should also be extended to Further Education Colleges.

Science competitions

Employers we consulted considered that competitions could be a key way of promoting science and engineering in schools. A recent national bridge-building competition for schools (www.woodforgood.com) was quoted as highly effective in improving awareness of engineering as a career.

The Energy Challenge 2004

With renewable energy seen as increasingly important, the Institute of Marine Engineering, Science and Technology held an energy challenge aimed at 14 to 15 year old students. They were asked to work with experts at a three day residential course on designing and building new energy solutions for a fictitious island off the coast of Scotland. The Challenge was supported by companies including Lloyd's Register and Shell.
www.lr.org/news/press_releases

In London, the LDA is also attempting to make science and innovation more visible. The LDA plans to open a London Innovation Centre, which will include STEM areas.

Foundation Degrees

Foundation Degrees, launched in 2000, offer a vocational approach to STEM study and are designed around a core of work-based learning. In 2003/2004, 24,000 students opted for Foundation Degrees, and this figure is expected to double by 2006. Foundation Degrees offer a chance to upgrade skills, for those with non-traditional qualifications or for those wanting a work-based route from Level 3. It could be advantageous for SMEs in particular to take a greater role in stimulating employer demand. And with increased student fees starting in 2006/2007, shorter Foundation Degrees could prove financially attractive to more students in the London area.[33]

How widening participation can help close the STEM skills gap

Reduced pool of STEM labour

Reductions in unemployment in the capital present particular challenges for all sectors in attracting high quality staff. It increases competition between employment sectors in capturing the interest and enthusiasm of potential new recruits. STEM-dependent sub-sectors, suffering disproportionately from a poor image or inability to compete with others in remuneration, have particular problems competing. The reduction in the pool of potential labour results in the need for more creative approaches in order to widen access to STEM.

Varying perceptions of science

Many young people and employers thought that more could be done to make London's diversity work in terms of promoting STEM studies and careers.

The perception of the status and value of science-related study and careers varies across ethnic groups. Children from developing countries often have a much more positive approach towards science and technology[32] than their British counterparts. However, it was apparent that some types of employment are more acceptable than others within certain cultures. For example, some Asian students felt parental pressure to become doctors but to avoid the 'dirtier' industries such as those linked to engineering.

Language

Some young people noted that the need to master the English language frequently poses problems for students in London. Although STEM vocabulary is largely universal, it was felt that progression to higher level STEM study could be a problem for students who lacked fluency in English. This could deter some students from choosing these subjects.

Disadvantage

Young people and teaching staff who we interviewed considered that studying and living in disadvantaged areas presents additional challenges to pursuing study generally, and pursuing STEM subjects in particular. This is due to a range of issues relating both to the school environment and pressures faced by some young people in the home.

"You get some seriously rough schools in London... it must affect those who want to learn, especially in secondary schools as people get distracted by everything else that's going on. So they think 'oh why should I bother', and so they give up."

Some young people described teachers spending more time controlling and disciplining disruptive students than teaching. This, in turn, impacts upon the concentration span of students who are keen to learn, often leading to apathy. Given that many young people perceive STEM-related study to be more challenging, and hence demanding of attention, this makes selling the potential of science effectively in disadvantaged communities crucial. The recruitment of high quality teachers to 'difficult' schools is also generally harder.

Ambition:Energy

British Gas, amongst others, is involved in a government initiative called Ambition:Energy. Sponsored by Jobcentre Plus, the scheme takes unemployed people and trains them to be domestic gas engineers in order to address the skill shortages in the industry. Overall it is operated in 70 locations across the country and in addition to gas installers, Ambition: Energy has helped people train and secure work as gas network operatives, water leakage technicians, pipe fitters and gas meter exchange operatives.
www.britishgasacademy.co.uk

The African-Caribbean Network for Science and Technology

The network has been set up by black professionals to help black young people to achieve qualifications and Jobs in STEM. Highlighting the achievements of African-Caribbean people in science and technology, it seeks to motivate young people to follow STEM career paths.

It also provides an educational information service and careers advice for those who have traditionally had difficulty in obtaining Information about academic and career opportunities in STEM.
www.ishangohouse.com

The Aim Higher and London Challenge initiatives (see Appendix 6) are actively working to drive up the motivation and aspirations of young people so that they feel confident and supported in aiming for higher levels of learning and achievement in schools. There is potential to build upon these initiatives to develop related actions specific to STEM.

Some Professional Institute respondents estimated that around 25% of all science laboratories in the country are unsafe or not fit for the purpose and that an additional 40% provide basic, un-stimulating environments. They fear that Inner City schools and FE Colleges may be faring worse in this regard. Inequalities in access to appropriate facilities are perceived to worsen the impact of other aspects of disadvantage.

A young person in our interviews commented that people from disadvantaged communities "...have less chances, they are open to less, they're not shown the full potential of mathematics and other things".

Our primary research showed that many students in disadvantaged communities have to work to supplement their family income, while fitting this in with their studies. In some cases they are the only family members in employment. Since STEM subjects often involve more timetabled lessons than other options, this excludes some young people from pursuing STEM.

The LDA is currently carrying out an analysis of the barriers faced by groups who are under-represented in the science and technology workforce. This will lead to recommendations for ways to attract new recruits from a more diverse labour market and encourage career progression.

New sources of employees

Many STEM employers are very keen to tap into additional sources of employees, including people who have been unemployed for some time, have had career breaks, or who have been otherwise economically inactive for some time for a range of reasons. However, such new recruits are likely to require support. Employers considered that this should include access to employability support generally (e.g. support with timekeeping and reliability); 'tasters' of STEM-related employment; and updating of technical skills. Better visibility of sources of new recruits, better access to knowledge about the potential of a more diverse group from which to draw staff, and clearer signposting to the support that is available could all encourage employers to recruit from a wider pool. Such measures would encourage employers to think and act more creatively around recruitment and workforce development.

Women in SET Resource Centre

The remit of the this new resource centre is to ensure that more women take up Science, Engineering and Technology study and careers. The centre, which is funded by the Government, will set up mentoring schemes to support women working in SET and research and make available data on spread best practice. One research area will look at why women do not return to SET careers after maternity leave.
www.setwomenresource.org.uk

The key findings of this report

The key findings of this report can be summarised as follows.

Many young people have **false impressions of STEM subjects**, seeing them as more difficult, less well taught and more boring than other subjects. Young people, careers advisers and teachers rarely see the STEM sector as offering stimulating, exciting and well paid career opportunities. Rather than being associated with innovation and new and emerging industries, many young people still associate STEM with the old economy.

Some STEM industries are increasingly dispersed within London. This creates a number of difficulties.

Low wage premiums in some science and engineering-related careers are a major problem in London. This makes some STEM-related careers (in finance for example) much more attractive than others.

STEM suffers from a lack of positive media coverage and although STEM advocacy and promotion is increasing, it is also un-coordinated. As a result increasing numbers of young people are choosing not to opt for STEM-related study and careers.

The **National Curriculum hampers teachers** who want to introduce interest and innovation into the delivery of STEM learning to maximise pupils' enjoyment.

The **crucial age in capturing students' interest in STEM is around 13 to 14**. This is the key time when proper career guidance, and stimulating teaching, can motivate young people to decide on further STEM study and eventual STEM careers.

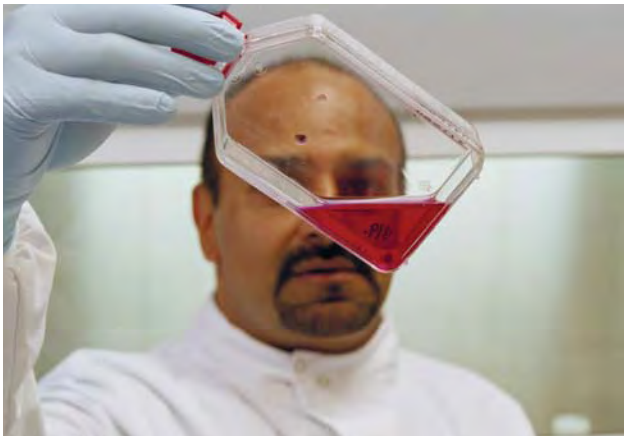
The **lack of vocational content in many STEM degrees** limits the relevance of study to the world of work - employers also report a **lack of general employability skills**, such as communication skills, amongst many STEM specialists. Many FE colleges offer training at too low a skill level, and also deliver skills for the old economy rather than providing those needed by expanding new technology or new engineering business areas.

SMEs have particular problems recruiting skilled employees, because they cannot pay the wage premiums expected in the capital.

Employers would like a **more co-ordinated and long term approach to skills funding, while skills provision needs to reflect the needs of STEM industries**.

It is extremely difficult to attract and retain good quality STEM teaching staff for schools, FE colleges and universities in London. The pay differential between FE lecturers and school teachers is causing severe problems in the recruitment and retention of STEM teaching staff in the FE sector. There is an acute shortage of Level 3 technicians caused in the main by poor pay which further undermines STEM education capacity within London.

Widening participation among under-represented groups can help close the STEM skills gap, as can **encouraging 'returners'** to STEM careers.



What needs to be done

This report has led to a number of priorities for action being identified.

To **improve collaboration between policy makers, STEM learning providers and businesses**, STEM studies and careers must be promoted.

- Consider setting up a **partnership of STEM learning providers**. This would take forward existing successful STEM initiatives and initiate new schemes to address gaps.
- **Develop a strategic STEM group** to include members from STEM industry and brokers of existing industry/provider links, beginning with London SETNET.
- Produce and **make available to learning providers a directory of the main sources of funding** available to support STEM.

To **improve the image of STEM subjects and careers**.

- Improve the information and support available to those who influence the study and career decisions of young people, so that they can provide informed advice on the opportunities of STEM. This should include raising the quality and frequency of Information Advice and Guidance services and careers support in schools and Further and Higher Education institutions.
- Support a regional (potentially national) public awareness **campaign to promote closer industry links to schools and F/HE institutions**.

To increase the numbers of young people studying STEM subjects at school, college or university.

- A high profile media campaign to raise awareness of STEM subjects and careers.
- Train Connexions and other career advisors to offer quality support to young people.
- Work to ensure young people can learn in an appropriate environment.
- Support the setting up of a STEM Learning Partnership.
- Encourage effective collaboration between employers, schools, colleges and universities.

To **enhance the capacity and flexibility of providers** of school, further and higher education to tailor provision **to meet employers' and individuals' STEM skill requirements**.

- Lobby for change to STEM teaching in schools by increasing flexibility within the National Curriculum, adding practical elements to STEM studies and providing space for innovation.
- Give more focus to literacy, numeracy and analytical skills in schools and F/HE institutions to improve generic skill levels.
- Set up programmes to enhance recruitment, retention and teacher/lecturer motivation including Continuous Professional Development options, consistent with the DfES Standards Unit 'Success for All' strategy.
- Cascade knowledge of the New Engineering Fellowship scheme and encourage other STEM areas to develop similar schemes.
- Raise the success rates of STEM learners by promoting and supporting providers' involvement in the teaching quality improvement programmes of the Regional Science and Mathematics Centres and Standards Unit Teaching and Learning Transformation programmes for Science, Mathematics, ICT and Engineering.

To **motivate and enable employers to seek out STEM training for their employees**.

- Support and encourage STEM employers to improve the skills and knowledge of their workforce by providing specialist and generic skills training customised to meet their needs. This should focus particularly on STEM/SMEs.
- Consider supporting larger company/SME training collaborations such as the Group Training Association model which provide training provision and services for employers.

- Produce and make available a range of clear information on ways employers can develop the skills of their workforce.

To **improve the quality, relevance and access to statistical labour market information** available to support STEM skills actions.

- Improve collaboration between agencies responsible for collecting, ordering and disseminating information on STEM labour market and skills in London.
- Agree a clear definition of the STEM labour market by identifying the Standard Industrial Classifications and the Standard Occupational Classifications that it includes.
- Produce and analyse comprehensive baseline labour market and data sets to guide and contextualise STEM actions.
- Produce a guide to available STEM labour market data sets showing how they can inform labour market policy making.

Extend the use of role models, ambassador schemes and technology competitions to promote STEM to young people and encourage closer links between STEM businesses and schools, FE colleges and HE institutions.

Seek to increase STEM teachers' salaries and to equalise pay between school teachers and FE lecturers.

Provide **STEM taster courses for students and potential 'returners'** to STEM.

To **attract new recruits from a more diverse labour market**.

- Recognise or update overseas qualifications and provide other support for migrants entering the London labour market at higher levels.
- Introduce support pathways enhancing basic skills, ESOL, and employability for people wishing to pursue STEM study and careers.
- Build upon Aim Higher and London Challenge initiatives to drive up motivation and aspiration of young people to increase achievement in STEM studies.

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Appendices

Appendix 1: The national context. The Roberts and Lambert Reviews and the Smith Inquiry

Although this research focuses on the workforce implications of embedding STEM in London, a number of extensive reviews have explored the availability of STEM expertise within the United Kingdom (UK) context and the implications for business competitiveness, the national policy framework, funding strategies to support improvements to embedding STEM skills within the UK workforce, and the allocation of public funding to support the objectives emerging from those reviews. Most of the key facets and competitiveness implications of these reviews have a clear resonance with the particular issues facing the capital.

Perhaps the most significant of the Reviews for this research are:

- the Roberts Review: "SET for Success" 2002
- the Lambert Review of Business-University Collaboration 2000
- the Adrian Smith Inquiry into Post 14 Education, "Making Mathematics Count" 2004.

The Roberts Review "SET for Success" 2002 identified the following key issues with regard to the supply of science and engineering skills in the UK, including significant problems inherent within the education system. Combined with other characteristics of many science, technology and engineering industries, these represent a significant brake on economic competitiveness. Key findings include.

- Although the aggregate numbers of students with broadly scientific and technical degrees have risen in the last decade, there have been some significant falls in the numbers taking physics, mathematics, chemistry and engineering subjects at A-level, degree and PhD level. Furthermore, highly skilled scientists and engineers often have excellent technical knowledge but lack the transferable skills and commercial awareness to apply this knowledge in a business environment.
- The experience of children in school is crucial to their subsequent education and training and to their careers. There are significant problems that need to be addressed in our primary and secondary schools.
  - Shortages in the supply of science and mathematics teachers.
  - Poor environments in which the practical aspects of science, design and technology are taught.
  - The tendency of courses not to inspire and interest pupils and teachers, and the failure of GCSE science courses to reflect what students are likely to encounter in everyday life. Students are being discouraged from thinking for themselves when there are real opportunities for discussion about contemporary scientific controversies, such as the MMR vaccine, hormone replacement therapy, asteroids, cloning and genetically modified food. At the same time, practical work has become "a tedious and dull activity", while course work is "boring and pointless".
  - The GCSE science curriculum being over-prescriptive. Both teachers and students are "frustrated" by this, and it turns students away from science because they lack the flexibility to explore areas that interest them. It kills the interest in science that may have been kindled at primary school.
  - The lack of role models in industry, business and HEIs, at all levels, who are able to inspire and enthuse the students and inform teachers.
  - Other factors - such as differences in the level and quality of careers advice - that affect pupils' desire to study science, technology, engineering and mathematics at higher levels.
- Secondary school and FE teacher training needs enhancing.
- Primary school teachers are often not trained in specific subjects.
- There are serious shortages among mathematics, science, ICT, design and technology teachers because of a lack of competitive remuneration as well as other key issues.
- Continuous professional development is often not undertaken by science and mathematics teachers. This affects their teaching and their motivation.
- School laboratories are not, at present, up to a satisfactory standard, and are certainly not good or excellent; and there is a serious backlog in equipping and refurbishing university teaching laboratories.
- Pupil-to-staff ratios in science classes are often very high, particularly in practical classes.
- There is a perception that science is more difficult than other subjects to get good grades in.
- The quality of A level students entering degree study is problematic, as undergraduate courses often do not pick up where A level courses end, and modularisation has led to students entering HE with a wider variation in subject knowledge.

- The nature and content of undergraduate courses is often perceived as irrelevant given the latest developments in science and engineering.
- Academic staff often have no industrial experience or continuous professional development.
- There are too few industry/academic links and there is little engagement between businesses, careers services and science and engineering departments at universities.
- University science courses tend to involve longer hours, limiting the scope of students to supplement their income by working part-time.
- PhDs in science/engineering do not help to meet graduates' salary or learning expectations.
- The participation of women and ethnic minority groups in science and engineering is disappointing; reflecting the conclusions of Baroness Greenfield's report.
- Careers in R&D do not match or surpass other opportunities in terms of initial pay, salary progression, career structure, training and professional development and recruitment mechanisms.
- Industry's response to attracting and retaining high quality, able staff will be crucial. Remuneration, careers structures and work experience have the potential to reward or deter a workforce of the calibre required for specific sectors.

The Lambert Review of Business-University Collaboration 2003 made a number of important recommendations that are particularly pertinent to the London-specific issues examined in this report. These include:

- New forms of formal and informal networks should be encouraged between business people and academics.
- Universities should provide more information on student employability, and businesses should play a greater role in influencing university courses and curricula.
- The Regional Development Agencies should play a greater role in:
  - facilitating knowledge transfer across their regions
  - strengthening business/university links
  - supporting university departments that clearly demonstrate strong support from business, to increase business-university collaboration.

The Adrian Smith Inquiry into Post 14 Education "Making Mathematics Count" 2004 clearly recognised that mathematics occupies a special position within STEM. Mathematics is a major intellectual discipline in its own right, as well as providing the underpinning language for the rest of science and engineering and increasingly for other disciplines in the social and medical sciences. It underpins major sectors of business and provides individuals with empowering key skills. Smith concludes that many of the generic problems identified across science and engineering in SET for Success (2002) manifest themselves most acutely in mathematics. The Smith Inquiry identified three key issues of concern.

- There is a shortage of specialist mathematics teachers, particularly in England and Wales.
- There are weaknesses in the current assessment and qualifications framework, meaning that the needs of many learners and the requirements of many employers and HE institutions are not being met.
- There is a lack of resources, infrastructure and a continuous professional development culture to support and nurture teachers of maths.

The outcomes of the above reviews have significant implications for the ways in which STEM is approached individually and collectively by and within schools, F/HE institutions, Professional Institutes, government skills and business support agencies and industry.

Appendix 2: The methodology used in this report

This appendix presents the techniques employed by consultants Rocket Science in conducting this research, the rationale for those techniques and the list of organisations consulted as part of the Primary Research phase.

The research was underpinned by the need to test the following five broad areas of action, which the Flagship Group had already identified as needing to be addressed.

- Providers should have enhanced capacity and flexibility to tailor their provision to meet employer and individual STEM skill requirements.
- Links between providers and employers could be built upon, celebrated and developed.
- Employers should be better able to access the individuals they need to meet their STEM skill needs.
- Employers could be more motivated and empowered to seek out STEM training for their employees.
- Young people could be more motivated to pursue STEM studies and careers.

The conclusions of this research strongly confirm that action to address the above five areas is pivotal in tackling STEM shortages within London.

Focus group interviews

Focus groups with young people

The qualitative research attempted to identify:

- students' aspirations in relation to STEM at university and in their careers
- students' associations with STEM careers, including stereotypes
- what excites the students about STEM and why – who or what were the major influences
- what are the perceived current problems in teaching, at school, in London, and how can they be tackled
- the importance of location in the choice of university and career
- how the provision of science and technology education can be improved.

Three focus groups were consulted in colleges of Further Education (two in sixth forms and one on an Access Course) and one in a university. In addition, the researchers participated in a focus group organised as part of the Islington 14 – 19 Pathfinder "Making it Work in Health Sciences and Medicine" project – a National Health Service University-sponsored initiative aiming to develop methods to embed career progression-readiness skills into 14 – 19 learning.

Participants were selected as being representative of students of science/technology or engineering, and students of non-STEM subjects. Participants were sourced by teachers and also through an advertisement in the careers office at the university. Each group consisted of between 5 and 12 students, aged between 16 and 26.

The focus groups took place on 23 and 24 March and 1 April 2004.

Tape recordings were made of each of the group sessions, which were later transcribed. The anonymity of individuals was not retained, and so in many cases it was possible to attribute quotes to specific people for cameos or case studies. A review of the transcripts was then made in search of words and phrases that might show common trends and differences in response. Each 'subject area' was then tabulated with comments showing the similarities and the differences between them.

Individual interviews and questionnaires

An individual interview can give in-depth information. One disadvantage is the absence of other respondents that would allow opportunities for argument and discussion.

Critics claim that interviewing individuals is largely intuitive, "soft" and relativistic and that there is often a blurred line between fiction, journalism and study (Creswell, 1998). Limitations are due especially to the small sample sizes in this type of research, and their intrinsic subjectivity. Bias can, however, be minimised by cross-validation and by increasing the numbers of respondents.

STEM individual interviews with institutes, Federations and F/HE institutions

It is recognised that F/HE institutions play a crucial role in STEM skills provision. However, they are not the exclusive providers of STEM skills development. The insights of Research Institutes and Professional Institutes were, therefore, sought as part of the research, given their various roles as quality assurers, custodians of knowledge on employer requirements and initiatives, and providers and promoters of STEM skills-related continuous professional development and careers.

Individual interviews attempted to identify the thoughts and views of institutions and federations, as well as those of school teachers, university lecturers, researchers, students and employers.

In all cases either an aide memoire (a semi-structured interview tool) or a structured questionnaire was used. This was pre-checked by a member of the Flagship Group and piloted with a small number of institutes, teachers and students.

The research attempted to identify amongst other things:

- what is the main work the federation undertakes
- how it engages with young people, schools, universities and employers
- examples of best practice, and what else is needed
- what can be done to help London keep young people involved in STEM subjects
- what can London do overall to improve the provision of science in the capital?

Due to the short time scale of operation, it was decided to send Federations and Institutions a questionnaire, which could be responded to by email, by phone or face to face with the researcher. Federations and Institutions were chosen by the STEM Flagship group.

The following were contacted by an email on 12 March 2004, with a follow up three weeks later.

- Association of Science Education.
- British Association for the Advancement of Science.
- Engineering Employers Federation.
- Institute of Physics.
- Institute of Materials, Minerals and Mining.
- Institute of Mathematics and its applications.
- Institute of Road Transport Engineers.
- Institute of Agricultural Engineers.
- Institution of Chemical Engineers.
- Institution of Civil Engineers.
- Institution of Electrical Engineers.
- Institution of Incorporated Engineers.
- Institution of Mechanical Engineers.
- Institution of Structural Engineers.
- Nuffield Foundation.
- Royal Society.
- Save British Science.
- DiverSETy/SET for women.
- SETPOINT/SETNET.
- WISE.

A total of eight separate federations responded by email and fax or were interviewed on the phone or face to face. Due to the crucial role of SETpoint in STEM throughout England, the individual area-specific co-ordinators throughout London were interviewed, in addition to the overall London co-ordinator.

Those interviewed included:

Steve Smyth	SETpoint overall co-ordinator for London
Andy Piggott	SETpoint London West
Caroline McGrath	SETpoint London South and ex-ASE field officer
Peter White	SETpoint North London
Tim Mahoney	SEMTA
Clare Donovan	Engineering Employers Federation
Sarah Clayton	DiverSETy (DTI)
Andrew Hunt	Nuffield Foundation
Mark Organ	Society of Road Transport/ Operations Engineers
Daniel Sandfordsmith	Institute of Physics
Rajni Sharma	Institute of Civil Engineers

The results/interviews were written up and a review was then undertaken.

Teachers/lecturers/researchers/students (other than responses elicited through focus groups)

The research attempted to identify several aspects.

- Positive and negative aspects of undergraduate and postgraduate STEM study.
- Current problems in the teaching and learning of STEM subjects, with possible solutions.
- Aspirations for the future (for undergraduates).
- The relationships between schools and employers.
- The causes of disaffection with STEM in young people, and possible solutions.

The schools and colleges were chosen by the STEM Flagship group, with the addition of Imperial College at the strong suggestion of one of the interviewees among the Federations/Institutions. The following were interviewed face to face, or responded via email:

Sir George Monoux Sixth Form College:

John Douglas – Director of Lifelong Learning

Dr Ian Elliot – Head of Biology

Peter Barnwell – Biology teacher. Co-ordinator for Biology Master Classes

Moray Bayliss - Director responsible for Science and Student Services

Gareth Machin - Mathematics teacher.

Richmond upon Thames College:

Laurie Prescott

Paul Luton – Chemistry teacher

Pat Mingham – Chemistry teacher

Chris Askwith – Physics teacher.

College of North West London:

George Palamidas – Tutor of STEP in Computing, Maths and Science, and Maths lecturer.

City University:

Wilma Martinelli

Dr P Speare – Deputy Dean, School of Engineering and Mathematical Sciences

Dr Andrew MacFarlane - Lecturer in Information Science (teaching and research)

Dr Sara Jones - Research Assistant, Centre for Human Computer Interaction Design

Oliver Bowen – PhD in Music Information Technology, part time Maths tutor.

It was decided to send lecturers, admissions tutors, researchers and students a questionnaire, which could be responded to by email, by phone or face to face with the researcher. This was to give extra quantitative support to the in-depth interviews mentioned above. The following lecturers, researchers and students were contacted by an email on the 17 and 18 March 2004, having been selected specifically from their respective websites.

48 admissions tutors/directors of studies, lecturers and senior lecturers, three work-based learning advisors, five postgraduate officers, 73 research assistants and research students at City University.

69 engineering students and 77 Masters or 4th year engineering students at Imperial College, London University.

Seven responses were received. However, the outcome was constructive and has informed case studies. In an attempt to gain a fuller response from students, questionnaires were distributed to City University students on April 1 with the result that 17 non-science undergraduates and 31 science undergraduates responded.

Employer case study: Individual interviews

Four employers were selected with the aim of capturing the opinions of a cross-section of STEM industries and companies. Selection was, however, constrained by the short timescale during which the research needed to be undertaken and the associated availability of businesses to contribute. Approximately 20 companies were approached and yielded four willing participants. The interviewee from each company was a senior staff member with a STEM academic background.

Interviews were undertaken with the following people:

Peter Martin, Technical Director, Black & Veatch.

Roger New, Co-founder, Proxima Concepts.

Mohammed Alavijeh, Co-founder and Chief Operating Officer, Pharmidex.

Peter Shawyer, Managing Director, Texcel Technology.

(See Appendix 4)

In addition, Senexis Ltd and British Gas completed questionnaires.

A standard aide memoire was used in each semi-structured interview that explored the following issues.

- Background to the company - including employment opportunities and demographics of the workforce.
- Skills and training - including core skills required, skills gaps and training methods.
- Recruitment and retention - including attracting the best applicants, hard-to-fill vacancies and career progression.
- Networking with other businesses, schools, FE/HE institutions, employer organisations and public agencies including SEMTA.
- Any other issues - including relocation, ideas of best practice and opinions on what further problems are faced in particular STEM industries.

Employer questionnaire

A questionnaire was sent out to employers, designed to cover the issues identified for the employer interviews. In an attempt to increase the number of respondents, a multiple choice approach was used wherever possible. The questionnaire was sent to 86 STEM employers, identified through databases provided by employer representative networks and other contacts and desk research, on 24 March 2004. A two week deadline was given and a reminder sent on 31 March 2004.

Two questionnaires were returned; the salient points have been summarised and appended to the employer case studies.

Appendix 3: Defining and obtaining data on STEM skills and industries in London

Although not the main focus of this research, an attempt was made to present a statistical overview of the supply and demand of STEM skills within London as part of this report. This was partly done so as to test the accuracy and accessibility of data sets available to support STEM research in London. However, real difficulties emerged in extracting accurate, consistent and complete data from the range of sources available. This is a cause for concern as it has the potential to result in inaccurate and inconsistent data being used in policy making. It also makes it hard to measure accurately the impact of policy intervention now and in the future.

Difficulties have been encountered for the following reasons.

- STEM industries do not fall into clear sectors which could dovetail with the standard industrial classifications - there is also a lack of shared understanding of which employment sectors and sub-sectors constitute STEM businesses.
- STEM skills have a very wide footprint and apply not only to industries that fall into classic types of business, which are most obviously reliant upon them, but also permeate a wide range of other sectors where they are also integral to the workforce skills base, for example broadcasting and finance. As a result, significant economic activity reliant upon STEM knowledge, expertise and skills is commonly unrecognised as such.
- Labour force and business survey reports frequently talk of business need in overall terms and, with the exception of manufacturing, tend to favour in-depth analysis reporting on the main growth sectors in London. It has proved very hard to identify data that is specific to, and comprehensively represents, STEM sectors and skills.
- It is difficult to navigate accurately between the many agencies that conduct and disseminate research in London, to identify who holds what data and more importantly, identify what data is available to support STEM research.

The key statistics relating to STEM industries and jobs in London presented in this report are as robust as possible, but almost certainly underplay the prevalence and importance of STEM business in London and the extent of the workforce in STEM-related industries. The skills needs highlighted through the secondary (desk) research are drawn primarily from the family of industries represented by the Science Engineering Manufacture Training Agency (SEMTA) Sector Skills Council and E-Skills, the Sector Skills Council responsible for Information Communication Technology.

We have sometimes referred to this family of industries in the report as the more 'traditional industries' associated with STEM – those that most people readily identify with science, engineering and technology. It was considered that these did include an appropriate range of STEM industries from which to draw initial conclusions on opportunities and needs, particularly as the skills issues explored in more detail in the supporting primary research extend beyond those sub-sectors.

Due mainly to the data collection issues outlined above, the requirements of other industries where STEM skills are integral to, but not predominant within a workforce, are not incorporated within this study. However, it is almost certain that the outcomes of this research will be pertinent to those sectors, but to different degrees depending upon the specific characteristics and image of the sector.

For example, the finance sector, which is underpinned by excellent mathematical and analytical skills, also needs access to labour that possesses the right mix of STEM-related and other generic aptitudes to enable it to innovate and succeed. The finance sector is, however, a case apart from many of the capital's other STEM sectors such as traditional engineering/ manufacturing, as it can provide highly paid and, from the viewpoint of many, high-status employment in attractive central London locations. These differing realities mean that the finance and traditional engineering/manufacturing sectors tend to have both common, but also very different challenges when seeking to deal with their STEM skill needs.

Employer Case Study Individual Interviews

Case Study 1 - Peter Martin, Black & Veatch Consulting Ltd 24 March 2004

Interview with Peter Martin and Raymond Coe, Technical Directors

The Company

Founded in 1890, Black & Veatch specialise in the engineering fields of water, the environment, energy, and information. They employ civil, mechanical, electrical and chemical engineers and environmental scientists, and provide consultancy services both in the UK and overseas. They have locations throughout the UK and their London offices are located in Redhill, Surrey, near to the town centre.

Employment

Employment opportunities

Black & Veatch undertake one round of graduate recruitment per year, with applications at the end of the year, interviews around Easter and employment in the summer. Interviews are pre-graduation. They recruit into all country-wide locations, although Peter reported that catchment is often most difficult in the South East. Peter reported a definite reduction in both the number and quality of applicants over the past few years, and increasingly the company is looking to recruit good generalists rather than those with an excellent degree. Additionally, the quality of degree courses varies greatly and many firms only look to recruit from particular universities. Increasingly, engineering firms are competing for the best civil engineering graduates, and competition is fiercer in the South East because the wages are less locally competitive in this region. For example, at Black & Veatch, an MEng graduate will start on £19,000, which does not compete with some numerate city jobs. This is largely as a result of the competitiveness within the industry that results in charges for pieces of work being constantly pushed down. Peter did point out, however, that engineering offers advantages that other City firms do not, including flexible working hours, a good work-life balance and a structured training programme. Raymond pointed out that, per working hour, engineers are often paid as well as their City counterparts. Peter also believes that Black & Veatch in particular are competitive as a result of their easy-to-reach location and proximity to an urban centre. After employees gain Chartered Engineer status, there is some drop-off in employment but this is usually managed by employing Chartered Engineers trained in other companies.

Skills
Most posts require an engineering or science degree, more specifically a 1st or upper 2nd class degree or MSc. PhD students may also be employed but the employment focus is usually on generalists since it might be difficult to keep post-doctoral recruits engaged in their subjects of interest.

Skills gaps
Graduate applications are increasingly lacking in non-degree-specific skills including general contextual understanding, maths/numeracy and engineering logic. There are also gaps in literacy skills and report writing and these problems are usually picked up from the CV and covering letter. Additionally, Raymond pointed out that there is a lack of candidates with basic level skills, including HNDs, and there are fewer opportunities to enter the field at this level.

Recruitment methods
Graduate recruitment is through advertisements in standard engineering journals, as well as through a scheme whereby existing employees revisit their old university careers fairs. With a good reputation for training, Black & Veatch also receive CVs on spec.

Higher level jobs are advertised in New Civil Engineer magazine, the Daily Telegraph and specialist publications. The company also use two specific recruitment consultants that specialise in this area, and are happy with the service they receive. Potential applicants make contact through the website. Employment is also common from Commonwealth countries since qualifications are transferable and, in areas such as infrastructure, it is easy for the Company to sponsor an employee, allowing them to remain working in the UK. Such recruits also often have several years of experience.

There are additionally some new pools of recruits emerging, including the over 50s and female applicants.

Training
Following graduate recruitment, employees undertake structured on-the-job training leading to Chartered Engineer status. This training is focused on the needs of the company but certified by a Professional Institution (such as the Institution of Civil Engineers). Black & Veatch are a sufficiently large company to run their own training programmes, although in the past they have offered places to other businesses but they are too stretched internally to do this any more.

In addition to the on-the-job element, there is also formal health and safety training, and training in project management, team work and technical skills. There is a professional exam after 4 to 5 years. The work is made up of written submissions, presentations, interviews and essays. There is a low drop out rate, although some employees might choose not to go for full Chartered status. All of the training is done in working hours, although there may be a requirement for some evening revision. Black & Veatch were the first company to offer water and environmental management training programmes for both engineers and scientists through the Chartered Institution of Water and Environmental Management.

In terms of other training, the LSC offers some funding for literacy courses and soft skills. Generally it is easier and cheaper to have people coming in to deliver courses than to send people on external courses, as they are a big company.

Raymond expressed the opinion that it would be good for the trainees and the company if they were permitted to take more trainees to client meetings, but there was a failure on the part of the client to understand or accept the importance of this.

External links

Academia
Black & Veatch are closely involved with Imperial College London and Cambridge University and send some employees back to university to study for mature MScs. They offer a bursary scheme to enable employees to do this. Additionally, they have limited feedback into the Imperial course and used to send an employee to lecture in design. The Imperial civil engineering degree is one of the few to have a design component that relates to industry needs.

Additionally, Black & Veatch help to set up MSc projects, with the students reporting back to the university and to the company. They also offer a few year-in-industry placements and some vacation schemes

The Company has some links with the MSc in Sustainability at Cambridge University. They were initial sponsors of the course and have limited input regarding course content. This link was set up through personal contacts. Black & Veatch also have links with Surrey University.

As a whole, Peter suggested that many engineering courses miss the mark. For example, there is a recent focus on environmental degrees, but there are not enough jobs for these graduates once they have gained the degree. Meanwhile, there is a shortage of civil engineers.

Peter suggested that it would be useful to feed back to schools and further/higher education. The Company currently work with some local schools including St Bedes, Redhill and Wallington High School. They would be willing to contribute to a national awareness scheme, providing that staff were willing to volunteer and it was well set up.

The Professional Institutions

The Professional Institutions offer a means for business to provide feedback to academia. In particular, industry seminars are attended by companies.

The Engineering Council contributes to training young people, and works with WISE (Women in Science and Engineering).

Media image

Peter also expressed some concerns about the media image of engineering, suggesting that addressing this might help in attracting more recruits. There have been recent moves in this direction, for example Raymond Coe pointed out that a recent episode of the BBC "If …" series was based on the 2002 State of the Nation report on energy by the Institution of Civil Engineers. Recently, there has been a national bridge building competition (www.woodforgood.com) for schools and this may also be a valid mechanism for improving awareness of engineering as a career.

Case Study 2 – Proxima Concepts 30 March 2004

Interview with Roger New, Co-founder

The Company

Proxima Concepts has been in existence only for a few years. It started off virtually and commissioned work in other research labs before setting up its own. Proxima started in an innovation centre in Oxford and are currently located at the London Bioscience Innovation Centre, together with other small biotech start-ups, which provides some economies of scale. The centre in Oxford had large communal facilities and sharing equipment helped keep costs down. The advantages of the current location include being able to borrow chemicals, and get cheap deals on old equipment. Although Roger has worked in academia, the company is not a university spin-out - instead Roger set it up to exploit ideas he had while working in other small biotech start-ups.

Proxima Concepts is working on three main projects and has undertaken one clinical trial with oral insulin at the Royal Surrey County Hospital. This work will be the subject of a presentation at the American Diabetes Association Annual Meeting.

Employment

Employment opportunities

There are three lab staff including Roger, one financial staff member and a colleague dealing with business development and licensing. They also have two sister/daughter companies that they set up to hold the intellectual property. Diabetology works in the areas of oral insulin and immune responses and stem cells, and the CEO is the Proxima staff member in charge of business development and licensing. Bone Ltd has raised funds in Australia. Each has one full time member of staff and several others who work part-time.

Skills

EU students are particularly suitable for the work because their training tends to be more vocational. Most staff are recruited at graduate level (rather than post-doctorate), largely because they are more willing to do the bench work required. Any solo projects that are out of the area of expertise of the lab head may be given to post-doctorates.

Skills gaps

Roger has found that one of the main problems with British graduates is the low standard of literacy.

Recruitment

Roger has brought most of the current staff with him. Many of the staff (in this and the other small companies in the building) are recruited from the EU, including Poland and France.

Pay is an issue – it is very difficult for small companies in particular to offer competitive pay.

Training

Training is mainly pre-recruitment in universities, although recruits will be trained in standard lab practice specific to the project.

External links

Academia

At present Roger is an honorary senior lecturer at King's College London and Proxima collaborates with academics in China.

They have no current mechanisms of feedback to universities but are keen to foster contacts. They do have an academic relationship with Australia. Although it is probably too late for this company, Roger emphasised that some feedback into the direction of university degrees may benefit other companies. Some of the newer universities offer more vocational degrees, and these often produce graduates who are more useful in the lab. They also have more placements throughout the course of the degree, allowing both sides the chance to experience what research is really like. French students also undertake this type of study.

Case Study 3 – Pharmidex 6 April 2004

Interview with Mohammed Alavijeh, Co-founder and Chief Operating Officer

The Company

Pharmidex was set up in 2002 by Mohammed Alavijeh and Alan Palmer, who have PhDs in neuropharmacology and pharmacology respectively. Alan started work at Cerebrus, which was then acquired by Vanguard Medical to become Vernalis. Mohammed spent 8 years working for Aventis and Rhone-Poulenc Rorer before moving to Vernalis where he met Alan. They set up Pharmidex to exploit their ideas in CNS drug discovery.

Employment

Employment opportunities

Pharmidex currently have 5 staff and are recruiting 2 more at present. They plan to expand to a team of 20 within the year.

Skills

Most recruits have PhDs, although they class an MSc plus 5 years experience or a BSc plus 7 years experience as approximately equivalent. Mohammed agreed that PhD graduates can be too specialised and employees are expected to go beyond this and show that they can also be good generalists. The research consists of a number of independent projects under an experienced lab head who usually is assisted by an MSc and BSc student.

Skills gaps

There has been a great deal of interest in all the jobs advertised; however, there are some skills gaps in applications. Although Pharmidex only work with mice and rats, pharmacology experience is scarce, particularly experience of working with animals. Vivisection tends to have a bad reputation in the media and, as such, it is difficult for scientists to gain experience. Mohammed gave some interesting examples of the effects of the anti-vivisection movement. For example, Aventis closed down their research plant in Dagenham with the loss of around 1500 jobs because of problems with recruitment and with the costs of securing the site. The plant has now been moved to France where vivisection laws are not as strict, but this is not necessarily in the best interest of the animals. The primate research centre planned for Madingley, Cambridge, is now to be moved to China. The pharmaceutical industry in the UK is one of the few that is providing a trading surplus (and employs 80-100,000 highly skilled people) but unless the business environment is made more competitive and the actions of such campaigners are controlled, the companies will move out with the loss of many high quality jobs. Although the UK has improved, it is not as competitive as France, Germany or Singapore, for example. Mohammed said that Pharmidex has been approached by the Paris Development Agency – competition for new businesses to set up locally is fierce, and the UK should provide more incentives.

Location is a major factor in preventing skills gaps. Mohammed explained that locating in London is one of the only ways to get a good supply of applicants, but London poses many problems for a small business. The cost of living in London is high, so help for junior members of staff would be appreciated. Pay is also an issue, not least because the level of skill required to do such a job necessitates a long study period and thus greater student debt. Mohammed and some of his staff suggested that relocation allowances and discounted travel would help people starting out in the industry.

Recruitment

Pharmidex have recruited staff through advertisements in the New Scientist and plan also to advertise in Nature. They also run promotional campaigns in journals including Current Drug Discovery and have plans to run them in Modern Drug Discovery and Drug Discovery Today. These campaigns have sparked interest in the company and they have received speculative CVs as a result.

From the New Scientist campaign they had over 100 applications and have used computer software to narrow down the list. The software picks out words on the CVs (relevant to the project such as in vitro cell line/neuropharmacology) and selects appropriate candidates. This style of selection is used by many of the big pharmaceutical companies to scan for good potential applicants.

Training

Pharmidex have chosen London as their location mainly as a result of the calibre of job candidates. The universities in and around London produce quality graduates and there are far fewer recruitment problems for companies based in this area. Pharmidex has received some funding from the LDA for locating in an assisted area. There is also a training component to this grant. They have also won the SMART (Small Firms Merit Award for Research and Technology) Award.

Barriers to training

Further training grants would be very welcome. Around 0.3 to 0.5 of the company's budget is spent on training and, in such a fast moving industry, there is need for continuous investment in people. Scientific meetings, such as those of the IBC, European Federation of Pharmaceutical Scientists, Society for Neuroscience, and BNA, do help employees to keep their knowledge up-to-date; however, such meetings are very expensive for delegates and there are no concessions for small companies.

Mohammed additionally suggested that training grants for ICT courses, in particular in statistics, Excel and Powerpoint, would help. Training courses providing an introduction to the pharmaceutical industry, or incorporation of this content into degree courses, would also be welcomed.

External links

Academia

The company has several links back into academia. Both Mohammed and Alan are honorary lecturers on an MSc course in neuroscience at the University of London – a way of giving something back to the university from which they gradated. They also lecture on an MSc course in drug discovery at the London School of Pharmacy and host students from Imperial to do MSc projects in the Pharmidex labs. They use the lecturing sessions to try and challenge the students and can choose the areas to lecture. They may use this as a method of recruitment in the future, particularly by taking on the students who have worked in their labs.

Mohammed and his staff suggested that courses should contain less pure science and more applied, with time in industry. Students need training in more analytical techniques, a broader base and experience of pharmacokinetics/dynamics. Students should be encouraged to take part in exchange programmes and spend time in labs in the summer. Moreover, companies should be given grants to support this in terms of providing training and lab space, and in return they should be obliged to advertise their schemes. All studentships should also be better advertised with some cohesive system for feeding back to relevant university departments.

Other organisations

Pharmidex have some contact with the DTI and have been involved with Tomorrow's Company – a business-led think tank concerned with the way future companies should be governed.

Case Study 4 - Texcel Technologies 5 April 2004

Interview with Peter Shawyer, Managing Director

The Company

Texcel is an electronics manufacturing firm with around 70 employees. They are based in Slade Green, Kent. They perform both contract-led electronic design and manufacture for specific clients (in the commercial and military sectors, mainly in the UK) as well as producing their own remote system products mostly for blue chip companies (mainly international).

Employment

Employment opportunities

The company employs a variety of staff in software design, test engineering and general production. The demographics of the workforce are fairly even, with about a 50:50 split between men and women; however, the women tend to dominate in the semi-skilled roles while most of the skilled employees are male. Additionally, the age of the workforce ranges from around 22 to 65 across all roles. The location of the premises is both an advantage and a disadvantage. They are outside the major electronics areas of the UK so there are fewer skilled workers; however, there is less competition for these workers and so they can offer lower wages and have a lower turnover. Although the South East has pressures in terms of cost of living and wages, they are close to many of their clients.

Skills

The software designers (around 7 staff) mainly require a 1st class honours degree or an HND equivalent; test engineers (around 6 staff) generally have an HNC or NVQ equivalent, while the general production staff are unskilled or semi-skilled on entry. However, Peter was quick to point out that recruitment is not qualification driven; experience and expertise are equally if not more important.

Skills gaps

Recruitment has been easier recently because the industry has been undergoing a recession. As a result, the availability of staff has been greater and they tend to be better trained. However, this has not been the case in the past and is not expected to continue. Peter says there is a growing trend of people leaving the business. The semi-skilled staff found they can earn as much in a less intensive job such as in a supermarket while the more skilled, numerate employees may be offered better employment packages in other industries. Peter suggests that this is because the work is, by nature, demanding, stressful, working to deadlines. He also suggests that it is as a result of far fewer young people taking up science and maths subjects at school.

Peter discussed the problems they have with retaining higher-level staff. They often leave as soon as they have the qualification they are being sponsored to study for.

Recruitment

Texcel use personal contacts, newspaper advertisements, employment agencies and the job centre to recruit staff. Agencies are expensive and offer a variable service. The most successful mode of recruitment has been personal contact with local colleges and Universities.

Training
For the more skilled positions, any skill gaps are filled by sending the employees on external training courses at local colleges or universities. Staff working in the less skilled roles are trained in-house. It takes around 3 to 4 months, with little practical output, to get a higher-level employee up to speed. Staff in semi-skilled roles start production straight away but it may take up to a year for them to be fully trained.

Barriers to training
Peter explained that there are some grants available to help with training but that these are poorly targeted. Most insist on the employee obtaining a recognised qualification at the end of the course, and this is not always appropriate to the work that they are to undertake. The grants are also relatively inflexible.

Additionally, most of the training courses are provided through intermediaries, rather than the company being able to apply for the money individually. The aim is to provide the same opportunities for all (and avoid individual companies achieving financial gain from the grants) but in practice it means that the money is poorly targeted.

Peter is a member of an SRB group and is actively involved in trying to gain funding for training, but has had little success in getting money for exactly what he needs. Peter also professed a willingness to tap into other sources of employees, including welfare to work programmes, providing that there is funding available to subsidise wages while training is undertaken. He also suggested that such recruits need centrally run employee support programmes to encourage them into good working practices. He stated, however, that at present most initiatives are aimed at getting people into work, rather than targeting the companies that could help them.

External links

Policy makers
Peter expressed fears that there is a scattergun approach to funding provision, with too many poorly targeted schemes. He did not know of any methods by which to influence the LDA or anyone else, but expressed a willingness to do so. He said that there is some survey fatigue in the industry but if the process was made more transparent and easier to access, it would be better used.

Media image
Peter suggested that the media image of manufacturing is poor – jobs are perceived to be hard and there is no glamour attached. Additionally, workers in this profession are not respected.

Questionnaire result - Senexis Ltd

Kevin Stott, Founder/Chief Scientific Officer

The Company
Senexis is a new UK-based biotechnology company dedicated to the discovery, optimisation and early clinical development of novel proprietary technologies and drug candidates for the effective diagnosis and treatment of major ageing-related degenerative diseases associated with amyloidosis (protein/peptide aggregation) and other abnormal protein-protein interactions.

Skills and training
Kevin reports that new recruits in management have excellent skills, whereas recruits in administrative, specialist skilled and operative roles have only adequate skills. There is a lack of basic education in maths and chemistry and new recruits and the current workforce lack communication skills, especially written. More practical training in this area is needed.

Training for the roles offered by the company is mainly in universities, although in-house training provision could be increased with more funding and fewer time pressures. Although they don't use any at present, the company would be encouraged to make greater use of external training providers if the standard of teaching was better and there were more opportunities to cater for the specific needs of the company. The company would like to apply for more help in meeting their training needs but don't know where to look for funding.

Recruitment and retention
The company use their website, recruitment consultants, jobs.ac.uk and links with educational establishments to recruit. The service received from employment agencies and consultants is, however, far too expensive.

Positions most difficult to fill are for experienced scientists with a good solid background in maths and chemistry. Kevin reports that in his experience scientists have focused on soft biology but are unable to do basic algebra and calculations.

Networking
Senexis have links with UMIST and Cambridge Universities but are not aware of any employer coalitions. They would, however, be keen to see employer coalitions address recruitment problems.

Questionnaire result – British Gas

The Company

British Gas describes the qualifications of new recruits in specialist skilled roles as excellent.

Skills and training

British Gas experiences skills gaps at NVQ levels 2&3. The company has a long tradition of being able to attract recruits ranging from those with Modern Apprenticeships through to adult recruits and they train these recruits to the appropriate level to fulfil their roles. This training is mainly via in-house workbook or on-the-job training. More funding and a better standard of external training courses would encourage them to increase this investment in people; currently they rate external training provision as good to average but excellent value for money. They would, however, welcome opportunities to build into external courses modules relevant to the needs of the company. Additionally, they are active in training people through a government initiative called Ambition: Energy, sponsored by Jobcentre Plus, which takes unemployed people and trains them to be domestic gas engineers in order to address the skill shortages in the industry. They receive funding from the Learning and Skills Council for Modern Apprenticeships and Adult Learners. They are actively involved with the National Contracting department of the LSC and the local LSC at a district level. British Gas additionally sits on the Modern Apprenticeship Task Force.

Recruitment and retention

British Gas uses its website, newspapers and magazines, Jobcentre Plus and links with educational establishments in recruitment. As a major employer, they are frequently over-subscribed for applicants, although there is a recognised shortage of domestic gas engineers in the industry. Last year, they had 19,000 applications for 500 apprenticeships. Industry wide, London in particular suffers from a lack of skilled applicants but British Gas as a company does not. They suggest that this is as a result of the many small and medium sized businesses that do not put training at the forefront of their business.

Networking

British Gas has links to schools, colleges and higher education establishments. They have recently set up a schools liaison team to complement other activities they are involved with in schools. They are additionally actively involved with the National Employment Panel, are active members of Glasgow's employer's coalition and liaise with London's employer's coalition. They would like to see such employer coalitions actively address the sharing of learning and skills, recruitment and local training needs. There is also a need for a more regional approach to liaising with employers and this needs to start with the various government departments active in this area. They suggest that Jobcentre Plus, Learning and Skills Councils, Regional Development Agencies and the Small Business Service, amongst others, should work more closely together.

British Gas is involved with the Department of Work and Pensions, the Department for Education and Skills, the Department of Trade and Industry, the Department of Food and Rural Affairs, Learning and Skills Councils, the Equal Opportunities Commission, the National Employment Panel, the Engineering Technology Board and WISE Outlook, amongst others.

Finally, British Gas suggests that combining the efforts of employers whose core recruitment requirements are for STEM subjects would have a greater impact. This would also allow more people to understand the need for these subjects and see their practical application in today's society. The need to increase the number of young people taking up STEM subjects at school is critical to ensuring that the next generation of employees has the skills required to handle the technologically advanced tasks required by employers.

Appendix 5: Global perceptions of STEM subjects

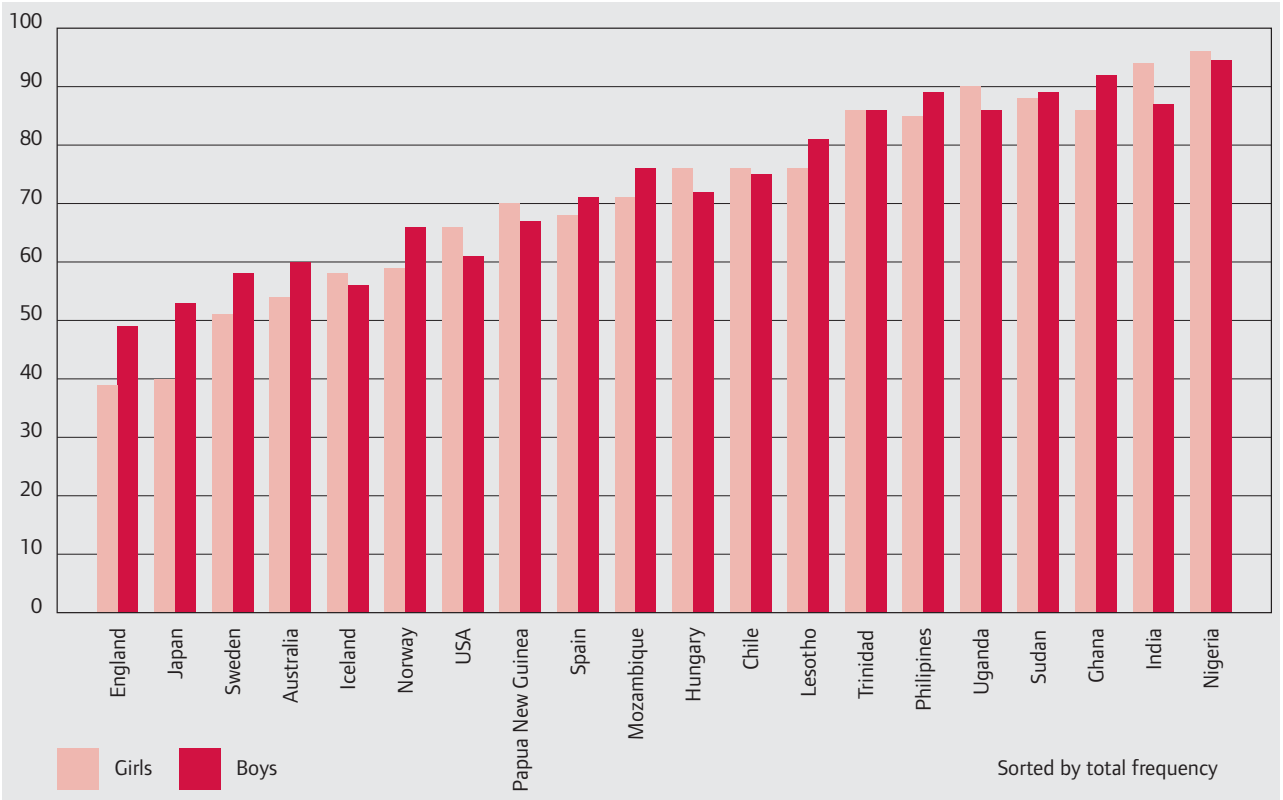
It is well documented that a key driver of industry is people: the attitudes, aptitudes, insights, skills, experience and motivation of its workforce is of crucial importance to whether or not a business succeeds.

A critical element in this mix is the pool of available young people from which industry draws. The following key outcomes of a 21 country study, the SAS- project: "Science And Scientists" published in May 2000 by Sjøberg from the University of Oslo, which explored the interests, experiences and perceptions of children from around the world, shows the context of the challenge facing the UK generally, in successfully embedding STEM skills within business. A total of 9,300 thirteen year olds – including 906 English children – responded to the questionnaire.

General views of science: children in developing countries articulate a much more positive view towards science and technology than children in more wealthy countries. Children in wealthier countries (mainly boys and including English children) tend to portray scientists as "cruel and crazy", while most children in developing countries seem to consider scientists as "idols, helpers and heroes". Sjøberg gives a tentative explanation for these observations: In developing countries, education is a "luxury" and a privilege, a resource that only a few children have access to. The motivation to learn and to study is high. This is particularly the case for girls, since the access to education is often denied them.

Usefulness of science for society as a whole: when asked about the relevance of science for society, England scored lowest for both boys and girls, with the fewest finding it important (only 35% of girls, 45% of boys) in comparison with other surveyed countries. Children in developing countries consider science to be of high importance to society. Gender differences are in general rather small. It is interesting to note that children in the most industrialised countries, which depend so heavily on science and technology, do not consider science to be of very high importance for society.

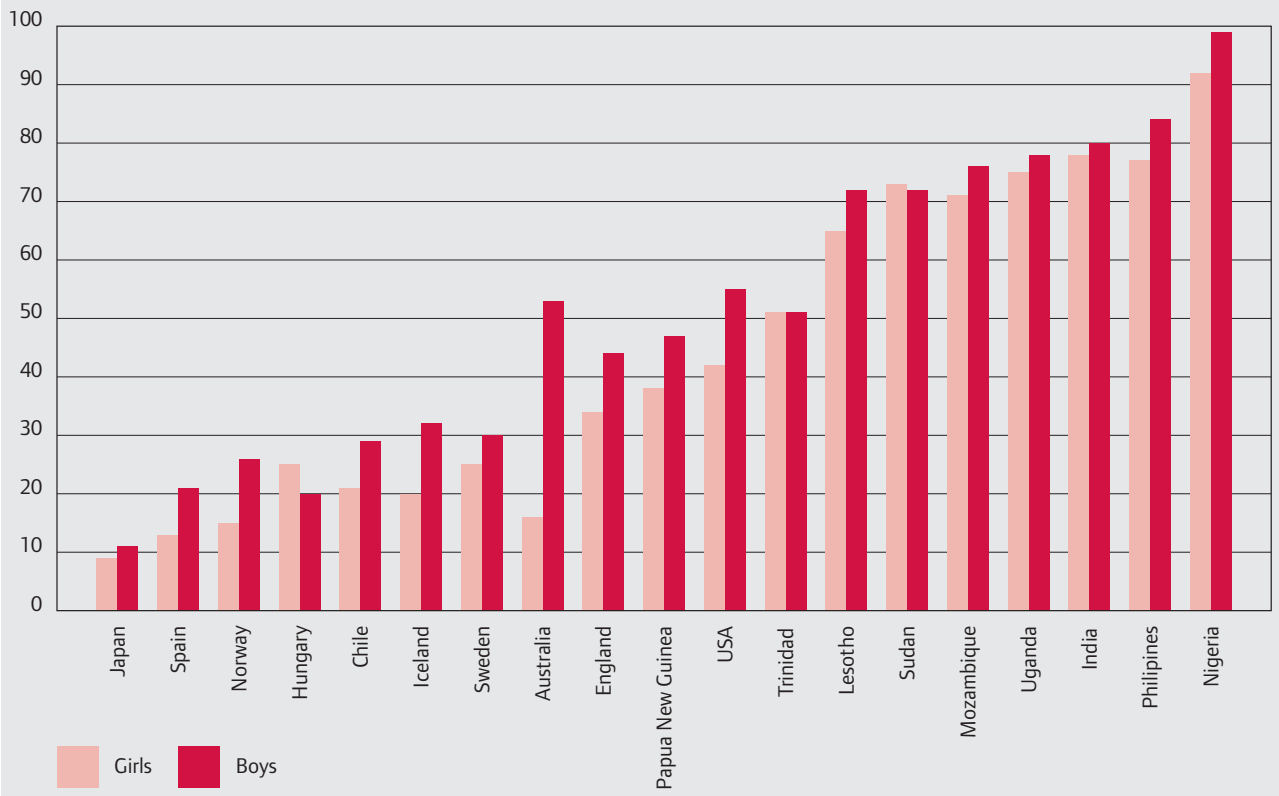
Science: Important for society!



Ease in understanding science

It is notable that in developed countries, young people do not find science to be easy. This may be related to the negative image many of them have of science subjects. England scores relatively well in comparison with other developed countries.

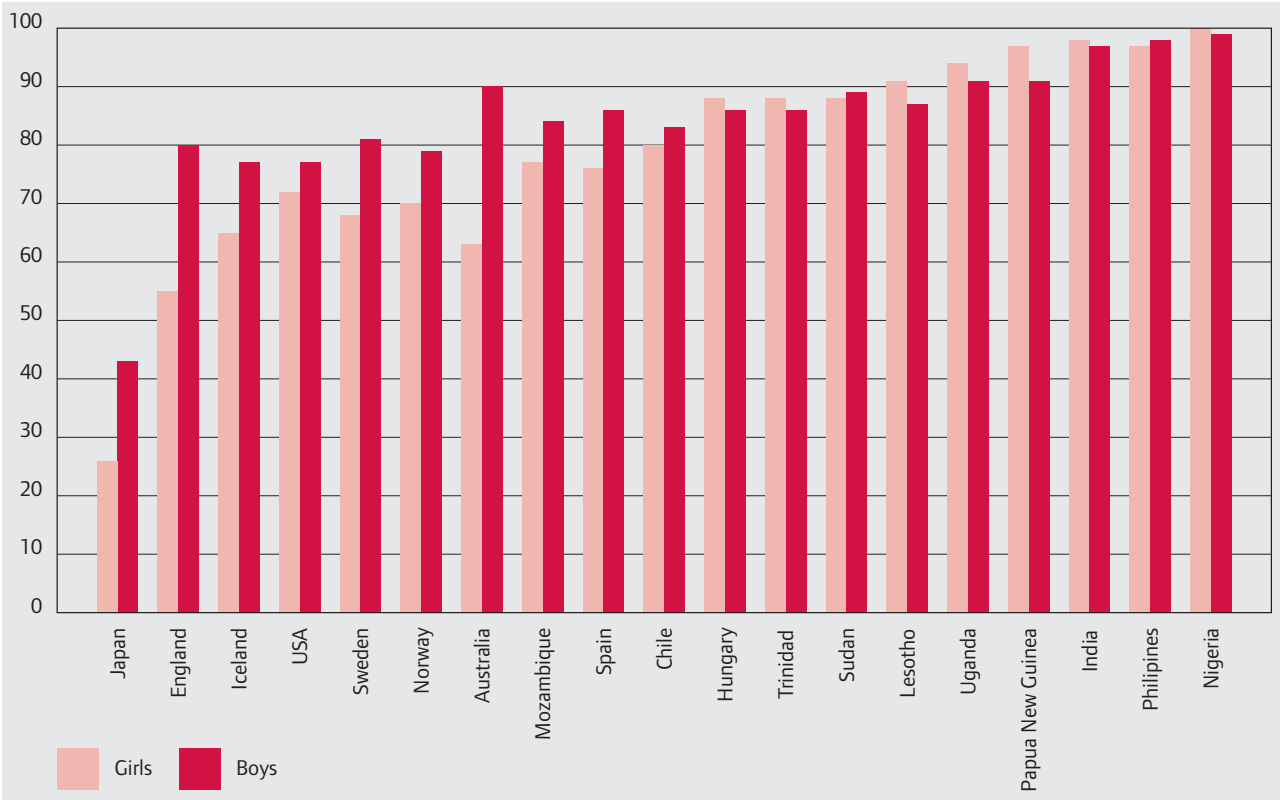
Science: Easy to understand!



Interest in and excitement about science

This table indicates a much wider gender gap between boys and girls in England than in some other developed countries including the USA, Norway and Spain.

Science: Interesting, exciting!



Appendix 6: Examples of UK initiatives to promote STEM skills

Websites

Name	Description	Find further information
Scenta	Scenta, a new portal for the science, engineering and technology community, aims to help inspire, inform, support and develop SET professionals. The website is a great starting point to look for competitions and initiatives.	www.scenta.co.uk
UPD8	Science UPD8 is a free service that lets teachers bring out the science behind the headlines while it's fresh in students' minds. Every week, the website alerts people to curriculum-relevant activities and news with a weekly email menu.	www.upd8.org.uk

Schemes

Aim Higher	Aims to increase the number of young people from disadvantaged backgrounds who apply for and enter higher education. A key purpose is to improve links between universities, colleges and schools.	www.aimhigher.ac.uk
Ambition: Energy	Ambition:Energy is sponsored by Jobcentre Plus and takes unemployed people and trains them to be domestic gas engineers in order to address the skill shortages in the industry. Overall it is operated in 70 locations across the country and in addition to gas installers, Ambition:Energy has helped people train and secure work as gas network operatives, water leakage technicians, pipe fitters and gas meter exchange operatives.	www.dwp.gov.uk
Association for Science Education	Runs a variety of area conferences that include practical workshops.	www.ase.org.uk
British Association Science Week	National Science Week takes place every March. It is an opportunity for people of all ages to take part in science, engineering and technology activities.	www.the-ba.net
Chemistry Week, the Royal Society of Chemistry	Chemistry Week consists of a series of events and competitions across the UK. Chemistry Week 2003 was all about pleasure and highlighted the way chemistry and the chemical sciences make all our lives that little bit more pleasurable.	www.rsc.org
City University and KPMG degree course	City University has introduced a degree course in conjunction with KPMG with guaranteed work placements for the students and potential employment at the end. KPMG and City panel interview the students.	www.city.ac.uk
DfES Standards Unit	The unit provides teaching and regional support networks for a range of subjects including Science, ICT, Engineering and Maths.	www.successforall.gov.uk
Imperial College's Pimlico project	Every Wednesday students have an afternoon free of lectures and go out and work with local schools. They will often take the initiative in determining what they will present to pupils and how they will do it.	www.imperial.ac.uk
London Challenge	London faces a unique set of educational challenges and London Challenge is about improving the opportunities for young people between 11 and 19. The three main aims are to transform education in 5 specific boroughs, support London schools experiencing the greatest challenges, and provide a better deal across London for students, teachers, leaders and schools.	www.dfes.gov.uk/londonchallenge

Name	Description	Find further information
NOISE	NOISE is a new nationwide campaign funded by the Engineering & Physical Sciences Research Council. It aims to stimulate young people's interest in science and engineering by making these subjects more relevant and accessible. It focuses on everyday topics such as fashion, sport and entertainment and highlights the science behind them.	www.noisenet.ws
Number Partners	Number Partners is a national programme that aims to promote the enjoyment of maths amongst children aged between 7 and 11. The activities are largely based on maths games and are aimed at enhancing the pupils' confidence and ability in maths.	www.bitc.org.uk
Planet Science Outreach group	The objectives of this project, managed by the Institute of Education, University of London, are primarily to enthuse and motivate pupils from groups that have traditionally lost interest in school science while at secondary school and to increase the attainment of such pupils in science and to identify activities which are particularly successful in this regard. The route by which these objectives will be achieved involves reshaping the summer term of the Science PGCE course at the Institute.	www.ioe.ac.uk
Royal Institution Mathematics Masterclasses	Royal Institution Mathematics Masterclasses are organised regionally, mainly by groups of local volunteers. Masterclasses are designed to stimulate and encourage mathematically promising students by introducing them to aspects of mathematics, including its applications, which are not usually found in the school curriculum.	www.rigb.org
SETNET Ambassadors scheme	A national programme created to encourage people with STEM skills to inform and enthuse teachers and students about these subjects as well as highlighting the importance of these subjects in everyday life and as a potential career.	www.setnet.org.uk
SETNET Events	SETNET run a wide variety of events including lectures about Harry Potter or Lord of the Rings, the 'Pizza project', Technology Tree, Vertical Challenge and Walking with Robots.	www.setnet.org.uk
Shell Inspire clubs	Shell has helped to set up community science clubs in schools to mobilise the community and interest young people in science, technology and sustainable development.	www.sln.org.uk/science/inspire/default.htm
Simfonec Innovation and Entrepreneur-ship intensive programme	This programme is aimed at equipping teachers of science, mathematics and technology subjects with the skills and tools to nurture and support innovation and entrepreneurship within schools. It is sponsored by NESTA and supported by Deutsche Bank.	www.simfonec.co.uk
SMART Awards	SMART (Small Firms Merit Award for Research and Technology) Awards are Government grants, given to establish the feasibility of innovations and inventions and to help the development of products through to the pre-production state.	www.smartwise.org.uk/prgramme.html
The Falkirk Initiative	Masterclasses for secondary school pupils to introduce them to practical science and STEM careers.	

Name	Description	Find further information
The Nuffield Foundation	Nuffield runs a variety of schemes including awards, the proficiency test competition and the science bursary scheme.	www.nuffield foundation.org
WISE	WISE has a range of initiatives and publications to give girls and women more information about opportunities and careers in SET.	www. wisecampaign. org.uk
Young Foresight	Young Foresight works with secondary schools to provide young people with the opportunity to understand how emerging technologies can be commercially exploited for future markets and provides them with the skills to create a successful product from conceptualisation, to design, to adaptability in the market place.	www. youngforesight. org

Schemes

CEME – Centre for Engineering and Manufacturing Excellence	CEME is a not-for-profit partnership aiming to encourage a diverse, socially inclusive, innovative range of learning activities that build engineering, manufacturing and business capability in the Thames Gateway.	www.ceme.co.uk
Centre of the Cell	The Centre of the Cell is a science centre based at Queen Mary College, University of London. It provides school children with an interactive learning experience that reflects the interests and aspirations of the internationally acclaimed Medical School and is particularly aimed at those interested in careers in medicine, dentistry and nursing.	www.nesta.org.uk
Group Training Associations	GTAs offer a wide range of training provision and services, mainly to SMEs, including NVQ assessment, advising on workforce development and analysing training needs, providing health and safety training and guidance, and management training, within a very tight financial regime.	www.semta.org. uk
London Biotechnology Network	The network was formed in response to the need for a co-ordinated approach to biotechnology development in London. It is the largest regional biotechnology organisation in the UK with some 800 member organisations. It also established the London Bioscience Innovation Centre to provide new incubator and laboratory facilities for biotechnology companies.	www.london biotechnology. co.uk
Science Learning Centre London	The national network of Science Learning Centres acts as a catalyst for creating inspiring, intellectually stimulating and relevant science education. Teachers and technicians use the Science Learning Centres to gain support and expertise in delivering science education that gives students the knowledge and understanding they need - both as scientists and citizens of the future.	www. sciencelearning centres.org.uk

Disclaimer

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